The
Philippine Agriculturist

VOL. XIII, NO. 6 NOVEMBER, 1924

EDITORIAL

"SAVE AND HAVE"[1]

It is generally admitted that Philippine Agriculture, as concerns the majority of the common people, is in an extremely backward state. This means also that the economic condition of the common people is neither sound nor safe. Where nature is most prodigal with her gifts and existence easy and simple, the common people live under a Damocles sword of debt and even famine, which a comparatively slight disturbance of the usual course may cause to fall at any time.

The extreme complexity of factors involved in agriculture as the chief human activity is rarely appreciated except by those who have made this a special study. The ills of the patient are differently diagnosed by every general practitioner and the number of patent nostrums on the market for the curing of the ills—real and imaginary—is very great. The man with a cold may be given medicine for his throat, when as a matter of fact his excretory system is out of order; or he may be given headache powders for pains in his head when he should be visiting an oculist; or be taking a tonic to improve digestion when he should be treated for dental caries. So in agronomy, reduced yields on certain lands may bring a very positive recommendation to use fertilizers, when the first need is actually an application of lime to correct a serious acidity.

In the last twelve years there has been an immense amount of discussion of possible means of improving our agriculture generally, without at any time a focussing of attention on the basic conditions underlying the whole structure. Here, just as in America and other countries, we must get down to a thorough study of the character and habits of the farmer himself, and to a clear recognition of the facts as they exist. Only by this pathway shall we arrive at better things.

One cannot live among the common people very long, anywhere in the Islands, without discovering a general thriftlessness among them that is little short of appalling. The majority have little or no savings, and an accumulation of debts both large and small is the general rule. Salary and wages are spent long before they are received—the income from a crop is obligated as soon as planted, or even before. There are, of course, occasional exceptions but these only prove the rule. It is through such habits that the farmer voluntarily delivers his very soul to the tender mercies of the money lender, the buyer, and the middleman, and the tenant becomes the inevitable bond-slave of the landowner.

[1] General contribution from the College of Agriculture No. 119.

A member of a prominent Manila firm sat at my front window one Sunday morning when automobiles were streaming by, going out into the provinces. I said, "View the prosperity of this country". His reply was couched in one word, "Jaw-bone!" Among ordinary people, how many automobiles are purchased outright from funds already earned and in hand? And even marriage and death are commonly likewise financed on a jaw-bone basis and usually far beyond the means of the persons involved.

Talking with a Negros sugar planter, I expressed doubt as to the success or even solvency of a business which after being in continuous operation for thirty years, did not have sufficient reserves to cut the next harvest, or to plant the next crop. He replied that this was not the correct way to judge of the profits in sugar production—that one should examine the accounts of the "Estrella del Norte!"

A few years ago unforeseen circumstances caused lively competition among buyers of tobacco in the Valley, with the result that producers suddenly found themselves with more money in pocket than they had ever had at one time before. The great majority of these producers lead a precarious existence, usually loaded with debt, with poor dwellings and with little of the comforts of life. Here, at last, was the means for them to pay up debts, to fix the house, and to put away a little against the "rainy day". What actually occurred? We got several residents in the Valley to secure data in a considerable number of cases. In a number of instances, a phonograph was purchased—and the leaky roof left unrepaired! In numerous other cases, a riot of "fiestas" followed, with "spreads" for all the friends and relatives, and some were not satisfied with one spread, but had a succession of them until the money was all gone. And so on! The next season found a majority of these tobacco growers right back where they were before the good prices came. How is such utter improvidence to be assisted? Can money be safely loaned where there is such entire business incompetence, such *thriftlessness?* Can agriculture be more highly developed on such a basis? Let us have at once a thorough investigation of the actual use made of funds obtained by each individual who has borrowed from the rural credit associations and I feel sure from many authentic reports given me, that it will compel us to revise our conception of the usefulness and practicability of rural credits in these Islands at the present stage of development of our common people.

There is widespread complaint about taxes—and these among the lowest in the world—even against the cedula tax. Yet a town fiesta in my town will easily call out general subscriptions, running from a peso or two to ten or fifteen pesos per person, with two bands and "spreads" in most of the homes.

My neighbors have no food stores except possibly a little rice or corn—many not even that. They run out each day to buy the necessary food and charge it where they can. And this constant charging is the common ruin of the little *tiendas* that are continually opening along the road, and as surely closing a little later, until the whole community is threaded through and through with a network of unpaid debt. Many of these people receive good wages, but in most cases it is more than spent before received. With debts unpaid they commonly go to the cockpit on Sunday and drop anywhere from one to five pesos or even more—to try the same hopeless thing over and over each time some loose cash turns up. Some attend the cine several times each week. The domino billiards played in many *tiendas* are gambling games pure and simple, with, of course, the only

certain profit going to the house. It is hard to see just what hope there can be for these people, with the legalized cockpit and other forms of gambling constantly in operation, tapping the very life-blood of the body economic. While these conditions commonly exist throughout the country, government aid in rural loans is like pouring water into a barrel with gaping cracks. The leaks should, so far as humanly possible, first be stopped. Gambling in every form must be prohibited, and the prohibition enforced, before we can hope to better to any measurable degree the economic condition of the people concerned.

The failure of the people generally to maintain any reserves—any savings—commonly compels them to sell the crop as soon as it is harvested and at the low price then prevailing, usually at a sacrifice; comparatively few are able to hold on through to time of scarcity and higher prices. It thus commonly results that the same people who have sold at a low price are a little later buying back the corn and rice for home consumption at two or more times the price at which they sold.

In associated barrios of the municipality where I live, there are several hundred young men, still "living with father," intermittently working for wages or harvest shares. Nearly all are habitués of dance hall, cine, cockpit, and gambling games. All might be out on homesteads helping to develop the country and to increase its taxable assets. Governor Cailles once came to this municipality and addressed these people in his accustomed forceful and attractive manner in these words: "What are you now—only Juan, trabajador, without property and without hope. Come over to Santa María where there is plenty of public land, take up 24 hectares, build yourself a little bahay, have pigs and chickens, raise your own food, and begin the planting of coconuts and abaca. Then what will you be—Don Juan, hacendero!" Did he get one to go? NO!

The suggestion was once made that every important official of the central and provincial governments should be required to spend two weeks of each year travelling over certain sections, meeting the people in all the barrios, pressing upon them with all the ability and force of which they are capable the meaning of two great fundamental economic necessities, first thrift, and second active homesteading of public lands, with politics absolutely taboo during this period. There is actually not a more important public service to be performed during the present undeveloped state of this country. It would be a gospel of hope to the common people.

In the United States, the effort to improve the economic condition of the rural population narrowed down in recent years to direct personal work with the individual, teaching him to keep accounts, to avoid every unnecessary expense, to stop all leakage, to cut down over-head, to secure a net profit, to build a safe reserve. A large and important office of the U. S. Government, that of Farm Management, is now devoted to this work.

But real thrift is a habit that must develop from childhood. Its first lesson must be learned in the home. Then, the years of schooling must secure a constant and unabated training in practical thrift. It is only the man who knows the possibilities of thrift, who can also realize fully his own independent power, and who can make the best use of the education he has received. *An agricultural education, even the best, can benefit but little the thriftless man, while to the thrifty man it is a tool of unlimited potentialities.* The Chinese are bred through gen-

erations to the most rigorous practice of thrift—an economic necessity in the dense populations of their own country. This it is that has enabled them to seize or control so large a proportion of the business of the Philippines, and in large sections of the country (as in Surigao and Leyte) to reduce the mass of the people to economic vassalage. Almost any Chinese seems able to create wealth from a penniless beginning, evolving with slow but steady certainty through bottle-buyer, *tiendero*, and *comerciante* to *capitalista*, or other similar positions.

Naturally also, the thrifty man never complains that he cannot get a start because he has no capital, since he is morally sure to have the capital before long. He is not the man, either, who seeks government aid, and he has little interest in rural credits. I once knew a young man with an income of twenty-five dollars a month who announced that he was going to be a banker. Even on that income he soon saved twenty-five dollars, which he loaned on an improved farm in approved banking style. Thirty years have passed without any change in his intentions or program. Today he controls *nine* prosperous and independent country banks in one of the best sections of the United States. Many young men now under my notice, receiving several times the above beginning income, are not saving a centavo, though in a country where it is far easier to do so. *Men cannot be helped, if they will not help themselves.* With right thrift habits *none will need help.*

One of the greatest stories in American history is that of the opening up of the Middle and Far West. Many men are still living on splendid farms in the West, who arrived on the ground with nothing. In fact money was, in most places, a useless commodity. Strong hearts, determination, thrift, and patience, built the West.

Let us, therefore, get back to the fundamental factor in all this business—the character of the individual. Let us recognize clearly that thrift is the bed-rock foundation of the whole structure. Cockpits and gambling must go! Definite education in thrift and business methods must be continuous from the cradle up, and effective and clear-cut steps must be taken to secure this. For with the blood tainted with thriftlessness, wastefulness, and improvidence, no patent nostrum will cure any of our surface sores.

Deeply thankful we should be that we have been able to produce even a few such coming men as Florentino Cruz and Leon Edrozo—outstanding successes, creators of considerable national assets from very small beginnings, throughout standing firmly on their own feet, asking favor from neither government nor family nor friends, and setting splendidly influential examples for all who may come after them. We have reason to expect many more such men from human material now in process of development, through higher education in agriculture.

In the United States, the education of the general public along thrift lines is going on constantly, as instance the following extract from current *Saturday Evening Post* (August 9, 1924). The educational need is just as keen in the Philippines.

No property can be built up, no industrial organization for the production of necessary goods is possible, without some form of saving, without a firm adjustment of expenditure to income. Surely it must be recognized by all who have given the subject any thought that the marked

individual success, the large fortune, is very commonly based upon saving. Obviously the first requisite for a large measure of business achievement is the power to grasp the ideal or idea of future gain so distinctly that the tendency toward present indulgence is controlled.

The largest chain of restaurants in the world was started and is owned by two brothers, two out of ten children on a farm. They worked from five a. m. to nine p. m. and saved until they had $1,600 for their venture.

John Studebaker went overland in a covered wagon. He had ten children, all of whom were taught, were indeed forced, to practice frugality and were compelled to suffer many hardships. The three oldest boys drove fifty miles into an adjoining country to work as harvest hands, and brought fifty dollars back to their father. Finally two of them started in 1852 making wagons with a capital of sixty-eight dollars and two forges.

An old man known for his wealth was one of six children, whose father, a country minister, never received more than $900 salary. Each of the six children received a suitable education for the business occupation he or she desired to enter. Yet the family was never known to leave a place with any unpaid debts.

Eastman, Carnegie and Duke all saved in the early stages of their careers. Marshall Field at twenty-two worked as a clerk for $400 a year, slept over the store, bought no clothes except a pair of overalls, and saved $200 of his salary.

One may jeer at Benjamin Franklin with his wise saws about thrift, but not at the banker near the center of the "money trust" who, when asked by the writer if he and his kind did not have too much power, replied simply, "Wealth built up by the careless and improvident has always found its way into the hands of the careful and provident, and always will."

Nor do I think that even the smartest of the intelligentzia who rail at thrift will get far in refuting the intricate, subtle and brilliant economic writings of Prof. F. M. Taylor, who in laying down in orderly detail the causes of large fortunes mentions near the head of the list the practice of thrift, keeping within one's income, especially in the early stages.

Says Mr. S. W. Straus, one of the notable business men of America:

Too often is thrift interpreted in the light of avarice, of parsimony, of everything which is the opposite of what real thrift ought to be. Some there are who preach thrift, who think that it is a mere matter of advising a man to change his habits from extravagance to thrift, but I believe that "the child is father to the man," and that if the principles of thrift could be inculcated in the youth of the country, the results would be found in the thrifty men and women into which they would develop.

Concrete courses of study have been developed by the National Committee on Thrift Education, and these courses are being generally adopted in the schools throughout this country. A very definite hold has been secured upon the children of today, as may be evidenced by the fact that in one essay contest, participated in by the children of New York City, between 300,000 and 400,000 papers were submitted.

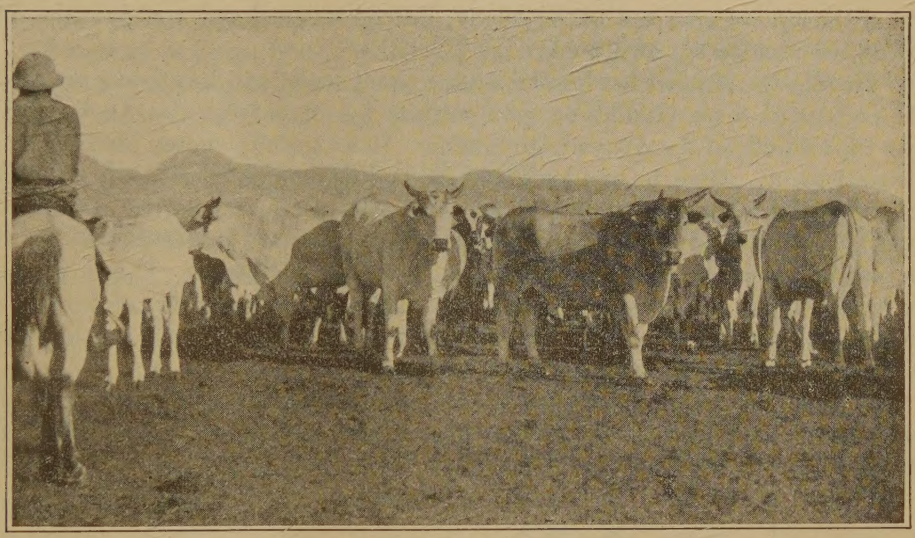
In the Philippines where educational activities of this sort represent one of the most urgent needs of the country, what is being done? What Philippines business men, or public men, are interesting themselves in this matter underlying the well-being and very life of the nation, as are Mr. Straus and many others like him, in America? Mr. Straus and other prominent business men are very active members of the National Committee on Thrift Education.

CHARLES FULLER BAKER,
Dean, College of Agriculture.

TWO PIONEERS

Much is said about the *potentialities* of the Philippines as a cattle country. The picture above gives a glimpse of an *actuality*.

Much is said also about the necessity of various kinds of "grants in aid" for young farmers. Cruz received no government aid, no personal aid; never asked for any. He goes the "Village Blacksmith" one better; he looks the government as well as the world in the face, for he owes not any man, not any government.



Just a Few of Cruz' ₱60,000 Herd

Florentino Cruz came to the College of Agriculture in 1911 with ₱2.00 in cash in his pocket and an exhaustless stock of grit in his soul. He left College in 1916 with the right to attach B. Agr. to his name and ₱300.00 in his pocket and not a cent of debt. He had never used the subtle "jawbone".

His first real job after graduation was, as a government employee, to develop the government cattle ranch in Dagumbaan in Central Mindanao. Pioneer work! This was wilderness work! Go today from Davao to Dagumbaan. Then try to imagine this fledgling farmer driving 400 head of cattle over this—not route, not trail, just country made up of mountains, rivers, forest, and cogon waste—his only help a few wild Manobos. Chow gave out, but there were weed sprouts which Cruz could boil and call greens. And his stock of grit did not give out.

Dagumbaan Cattle Ranch became a reality. The best paying reality considering "initial outlay, cost of maintenance, and ultimate value that has been carried out under government auspices".

And Cruz had proved himself. Proved himself so well that he was offered and accepted the position as Manager of Dean C. Worcester's Nellore Ranch, at a large advance in salary and the privilege of establishing his own ranch along side of his employer's. The original 600 head of cattle on Nellore Ranch has, under his industrious and efficient four years' management, increased to 1,500. And on Cruz' own ranch is a herd of 300 valued at ₱60,000 earned by his own efforts in less than seven years. This young man answered Opportunity's knock promptly. And outstanding success is his largely because he early learned that "A centavo saved is a centavo earned."

Leon Edrozo, B. Agr. '17, another of our pioneers, is a colonizer.

His first employment after graduation was a government job also. At a rather low salary Edrozo was appointed Superintendent of Abulog Agricultural Colony in Cagayan Province. Finding it impossible to make successful farmers out of the kind of men sent to the colony, Edrozo resigned and went into the colonizing business on his own hook.

He selected families having the stuff in them out of which pioneers are made. He persuaded these families to go with him far back from the Abulog River into the foothills of the Apayao Mountains. In a carefully chosen place he made his settlement. Here, he and his group are making homes, carving out a community, doing some real nation-building work. They are conquering Nature and doing it with their own hands, their own brains under the leadership of one who learned in this college how to utilize and how to control Nature. They are asking no "grants in aid." They are proving that "Diligence is the mother of good luck." In this little pioneer settlement in the north as on the ranch in the south, wealth is being produced not being just talked about.

It is of such as these two young men—and we've turned out others at this college and we're turning out more—that nations are made. "May their tribe increase."

—Emma S. Yule

ISOLATION AND IDENTIFICATION OF SOME OF THE SUGARS IN COPRA MEAL AND COCONUT WATER[1]

By Elias M. Caray

WITH THREE PLATES

COPRA MEAL

Studies on the nature of the carbohydrates of copra meal, an important by-product of the coconut oil industry, are very few and the information to be obtained from the literature usually does not go beyond the proximate analysis of the material. Biological studies of the meal have, however, been carried out at various places (1).

In a previous paper by the writer (2) the literature on the subject was briefly reviewed, a complete proximate analysis of copra meal given, and the nature of the carbohydrates of the meal summarized as follows:

Table I.—*The nature of the carbohydrates in copra meal.*

Carbohydrates.	In terms of oven-dried sample.	In terms of total carbohydrates.	In terms of total sugar.	In terms of total polysaccharides.
Sugars:	*average per cent*	*average per cent*	*average per cent*	*average per cent*
Sucrose	14.33	32.82	59.82	——
Raffinose	2.42	5.54	10.10	——
Galactose	2.42	5.54	10.10	——
Pentoses (as xylose)	2.40	5.49	10.01	——
Fructose	1.20	2.75	5.01	——
Glucose	1.19	2.72	4.96	——
Polysaccharides:				
Cellulose	15.55	35.63	——	78.93
Pentosans (as xylan)	2.22	5.09	——	11.28
Starch	0.87	1.98	——	4.39
Dextrin	0.58	1.29	——	2.85
Galactan	0.50	1.15	——	2.55
Total	43.68	100.00	100.00	100.00

As may be seen in Table I over one half of the total carbohydrates present are made up of sugars. In the present work it was the aim to isolate some of these sugars and subsequently to establish their identity.

[1] Thesis presented for the degree of Master of Science in Agricultural Chemistry from the University of the Philippines, No. 192; Experiment Station contribution No. 248.

MATERIALS AND METHODS

PREPARATION OF THE SAMPLE

In order to get copra meal free from contamination it was thought best to prepare the material in the laboratory. One hundred and fifty ripe coconuts were gathered from the College grove and made into copra in the ordinary way. The meat was dried in a Mayfarth No. 11[1] copra drier at from 85° to 100° C. for about four days. The resulting product which was brownish in color was stored in gunny sacks.

To obtain the meal, the copra was cut into small pieces and then shredded in a bagasse shredder until it could be made to pass through an 8-mesh sieve. It was placed in small cloth bags and the oil extracted with a hydraulic press under a pressure of about five hundred pounds to the square inch. The resulting cake was then ground in a meat grinder until most of it would pass through a 16-mesh sieve. The powdered material was dried in an electric oven at from 95° to 105° C. for at least six hours, then extracted with anhydrous ether for three days and finally dried again in the electric oven to drive out the ether. The oil-and-moisture-free sample was stored in glass-stoppered bottles. It is believed that in the preparation of the meal in the present experiment, conditions approximated those found in the usual way of manufacturing copra and oil.

EXTRACTION OF THE SUGARS AND PREPARATION OF THE SYRUP

Portions of about one kilogram each of the oil-free sample were treated with hot water (about 80° C.) with the addition of a little calcium carbonate to neutralize the acidity; the mixtures were stirred for about one hour. The liquid was extracted from the residue by means of a small hand press. The operation was repeated several times, the residue being moistened each time with fresh portions of hot water in order to extract the sugars as completely as possible. The combined extract was made neutral or very slightly alkaline by further addition of powdered calcium carbonate. Any precipitate that formed was filtered with suction and the filtrate then evaporated under reduced pressure to a thin syrup, amyl alcohol being added to prevent foaming (3). The syrup was treated with five times its volume of 95 per cent alcohol, previously neutralized with sodium carbonate, and then more neutral alcohol was added to complete the precipitation of the crystals (4). The precipitate was filtered off with suction and, after decolorizing with powdered bone black, the filtrate was evaporated *in vacuo* to a thick syrup. The brownish syrup was set aside in a desiccator. (No crystallization of sugars took place even when the syrup was kept in the desiccator for several months.)

METHODS OF ISOLATION OF THE SUGARS

Efforts were made to isolate sucrose and raffinose and the simple sugars, glucose, fructose, galactose and the pentoses (see Table I) by different methods.

Raffinose.—The following methods were used in the isolation of raffinose:

(a) The first process was adopted from Zitkowski (6) and is based on the solubility of lead saccharate and the insolubility of lead raffinosate at high temperatures. A portion of about 150 grams of the prepared syrup was diluted with water to about 50 degrees Brix. Fifteen grams of lead oxide were added, the mixture brought to a boil and then filtered immediately, the object being to remove any salt impurities. Fifteen more grams of lead oxide were taken to which por-

[1] Ph. Mayfarth and Co. Engineering Works, Frankfort o/M.

tions of the filtered sugar solution were added to make a thin paste. This paste was stirred for about one hour in the cold and then set aside until the next day. The main portion of the sugar solution was then heated to boiling and the lead oxide mixture added little by little, stirring constantly. The resulting mixture was allowed to boil for about 30 minutes and then filtered at once, through a cloth filter, keeping the mixture as hot as possible. (The object was to separate the soluble lead saccharate from the insoluble lead raffinosate.) The residue left in the filter, after washing thoroughly with boiling water, was held in aqueous suspension and decomposed by passing a stream of carbon dioxide. Any residue was removed by filtration and the filtrate then concentrated by distillation *in vacuo*. After purification with alcohol and decolorizing carbon, the resulting syrupy liquid was set aside in a desiccator over concentrated sulphuric acid.

(b) The other method used is that given by Burkhard (6); it is based on the high solvent action upon raffinose and the low solvent action upon sucrose, of absolute methyl alcohol. Clean, washed and dried wood-shavings were obtained. These were made to absorb a concentrated solution of the prepared copra meal syrup. After drying by heating in an air oven at 90°–100° C. for about six hours and then storing in a desiccator over phosphorous pentoxide for at least one week, the material was extracted with absolute methyl alcohol. The extract was diluted with water, boiled until the alcohol had all evaporated, then crystallized strontium hydroxide was added, stirring constantly. Any crystals that formed were separated by filtration and washed thoroughly with water. The crystals were held in aqueous suspension and a stream of carbon dioxide was passed through the mixture. Any residue was filtered and the filtrate concentrated by distillation *in vacuo*. The resulting syrupy liquid was dissolved at 60°–70° C. in as little 80 per cent alcohol as possible and then set aside in a desiccator over concentrated sulphuric acid.

Sucrose.—In trying to isolate sucrose, two methods were used:

(a) A portion of the prepared syrup was diluted with water (5); heated almost to boiling and then treated with a hot solution of barium hydroxide. After heating the mixture for a few minutes, stirring it constantly, it was filtered through a cloth filter[3] and the residue thoroughly washed with hot barium hydroxide solution. The residue which was supposed to be barium sucrate was then decomposed by treatment with hot zinc sulphate solution, precipitating the insoluble zinc hydroxide and barium sulphate and leaving the free sugar in solution. The precipitates were filtered and the filtrate evaporated under diminished pressure to a thin syrup. After purifying by repeated treatment with 95 per cent alcohol and decolorizing with powdered bone black, it was finally evaporated over a water bath to a thick syrup and set aside in a desiccator. Any crystals of sugar that formed were separated from the mother liquor and purified by repeated crystallization in alcohol.

(b) The following process was adopted from Steffen (6). A portion of the syrup was diluted with water to about 12 Brix and was then treated for about one hour in the cold with powdered freshly burned lime, stirring constantly. The granular precipitate that formed was filtered on a cloth filter, washed thoroughly with cold water and then decomposed in aqueous suspension by passing carbon dioxide to neutrality. Any residue was separated by filtration and the filtrate evaporated *in vacuo* to a thin syrup. After priming with a minute crystal of saccharose it was set aside to crystallize. The crystals formed were separated from the mother liquor and purified by repeated crystallization in alcohol.

[3] The filtrate from this was saved and used in the isolation of fructose.

Fructose.—The filtrate from the barium hydroxide treatment in the preparation of sucrose was carefully treated with zinc sulphate solution until all the excess barium was precipitated. After separating the solid barium sulphate by filtration, the filtrate was evaporated on a water bath to a thin syrup. This was purified by treatment with 95 per cent alcohol and decolorizing carbon and then evaporated on the water bath to a thick syrup. Fructose was isolated from this syrup by the following method adopted from Browne's method of preparing fructose from sucrose (6). A 10 per cent aqueous solution of the syrup prepared as above was made and cooled to about —5° C. with a freezing mixture of pieces of ice and common salt. The cold solution was treated with fresh, finely powdered calcium hydroxide in the proportion of 6 grams of the latter to 100 cubic centimeters of the solution. The mixture was stirred for about three minutes and then filtered rapidly, keeping the funnel cool with ice while filtering. The filtrate was placed in an ice box. Fine, white, needle-shaped crystals were deposited on the following day. These were filtered cold, washed with ice water and then decomposed in aqueous suspension with a solution of oxalic acid, taking care not to add excess of the acid. The mixture was filtered and the filtrate evaporated under diminished pressure, to a thin syrup. This was purified by treatment with 95 per cent alcohol and decolorizing carbon and then evaporated *in vacuo* to a thick syrup. After priming with a minute crystal of fructose the syrup was set aside in a desiccator over concentrated sulphuric acid. The crystals were then separated from the mother liquor and purified by re-crystallization in absolute alcohol.

Reducing sugars by the hydrazone method.—In the isolation of reducing sugars other than fructose, the method suggested by Browne (6) of first producing the hydrazones of the sugars separately and then decomposing them by acid or aldehyde to recover the sugars was used.

About 30 grams of the syrup were diluted with water and treated with phenylhydrazine hydrochloride and sodium acetate in the cold. The precipitate of hydrazones was filtered as soon as formed, washed with a little cold water and dried between sheets of filter paper. Fresh portions of phenylhydrazine hydrochloride and sodium acetate were added from time to time.

As is well known, the time of formation of hydrazones varies for different sugars. Filtrations were performed as often as possible—twice a day at the beginning, then daily and finally once every other day—in order to get the hydrazone of one sugar as free as possible from the hydrazones of other sugars. The different fractions of the precipitate were labeled consecutively 1, 2, 3, 4, etc.

The sugars were recovered from the hydrazones by the following method (6): The precipitate was treated with concentrated hydrochloric acid in the cold. The insoluble phenylhydrazine hydrochloride that was formed was separated by filtration and the filtrate which contained the free sugar neutralized with powdered lead carbonate. Any residue was filtered and the filtrate shaken with ether several times in a separatory funnel in order to remove the last traces of phenylhydrazine hydrochloride from the mixture. The purified sugar solution was then evaporated on a water bath to a thin syrup. After further purification by repeated treatment with 95 per cent alcohol and decolorizing carbon, it was finally evaporated to a thick syrup and set aside to crystallize. The sugars were purified by repeated crystallization in absolute alcohol. The purified products were dried in a desiccator over phosphorous pentoxide for at least two weeks.

The accompanying diagram shows the scheme of analysis followed.

ISOLATION OF SOME OF THE SUGARS IN COPRA MEAL AND COCONUT WATER

(SCHEME OF ANALYSIS)

150 Coconuts

Meat

Dried at 85°-100° C. for 4 days.

Cut in small pieces and shredded in a bagasse shredder to about 8-mesh.

Oil extracted with a hydraulic press at a pressure of about 500 lbs. per sq. in.

Cake ground in a meat grinder to about 16-mesh.

Dried in an electric oven at 95°–105° C. for 6 hrs.

Extracted with anhydrous ether for 3 days.

Dried in the electric oven at 95° C. for 3 hrs.

Treated with hot water (+$CaCO_3$ to neutrality). Stirred for 1 hour

Liquid extracted with hand press, washing the residue with hot water to complete extraction.

Combined extract neutralized with $CaCO_3$; filtered.

Filtrate concentrated *in vacuo* (50°-45° C.) Amyl alcohol added to prevent foaming.

Thin syrup treated with excess neutral 95% alcohol. Filtered.

Filtrate decolorized with bone black

Concentrated *in vacuo* to a thick syrup.

Water

Neutralized with Na_2CO_3; filtered.

Filtrate concentrated *in vacuo* to a syrup (50°–65° C.)

Treated with excess neutral 95% alcohol; filtered.

Filtrate decolorized with bone black.

Evaporated *in vacuo* to a thick syrup.

"Coconut water syrup"

(Analyzed in the same way as the *"copra meal syrup"*)

Copra meal syrup

Fraction I.

Treated with Zitkowski's method for Raffinose

Brownish syrup.

Dissolved in H_2O.

Fraction II.

Treated with Burkhard's method for Raffinose

Brownish syrup.

Dissolved in H_2O

Combined Solutions

Treated with strontium hydroxide in the hot. Filtered, washed with water.

Ppt. decomposed with CO_2. Filtered.

Filtrate purified with 95% alcohol and bone black.

Evaporated *in vacuo*.

Syrup set aside.

RAFFINOSE
(White solid)

Fraction III.

Treated with phen. hyd. HCl and sodium acetate in the cold.

Filtered as ppt. formed.

(41 fractions of ppt. collected.)

Treated with Browne's method of recovering sugars from hydrazones with HCl, etc.

Fractions 5 and 6	Fractions 19, 20, and 21.
GALACTOSE	GLUCOSE

Fraction IV.

Treated with Ba $(OH)_2$ in the hot (about 10 minutes). Filtered.

Residue

Treated with Zn SO_4 sol. Filtered.

Filtrate evaporated *in vacuo* to a syrup. (50–65° C.)

Purified by alcohol and bone black.

Evaporated on a water bath to a thick syrup

Set aside in a desiccater.

SUCROSE
(Crystals)

Fraction V.

Treated with Steffen's method for isolation of sucrose.

SUCROSE
(crystals)

Filtrate

Excess Ba $(OH)_2$ precipitated by Zn SO_4. Filtered.

Filtrate purified with 95% alcohol with bone black.

Evaporated on water bath to a thick syrup.

Treated with $Ca(OH)_2$ in the cold. (Browne's method of isolating fructose)

FRUCTOSE

METHODS OF IDENTIFICATION OF THE SUGARS

The sugars that have been isolated were identified by their specific rotations; by the melting points of their phenylhydrazones, phenylosazones, and para-bromophenylosazones; and in part by their physical properties, such as crystalline form, color, taste, solubility, and the melting points of the sugars themselves. The tables of melting points and other information given in Browne's Handbook of Sugar Analysis (6) and in Mulliken's A Method for the Identification of Pure Organic compounds, Vol. I (7), were used as guides. Hydrazones and osazones were also prepared from samples of known sugars when it was found necessary for purposes of comparison.

For compound sugars polarization before and after hydrolysis or inversion was tried, and the hydrolysis products determined whenever possible.

Mulliken's method (7) of identification based on the time of formation of phenylosazones under certain conditions was also used.

Photomicrographs of the phenylhydrazones, phenylosazones and para-bromophenylosazones of the isolated sugars were taken.

Determination of specific rotation.—Portions of the isolated sugars were accurately weighed and then dissolved in distilled water to make solutions of known volumes, using 10-cc., 25-cc., or 50-cc. graduated flasks. The solutions were allowed to stand from 4 to 6 hours to correct for mutarotation and then polarized in a 100-millimeter tube, using a quartz-wedge saccharimeter having scales graduated in degrees Ventzke. After reducing the concentrations of the sugar solutions to correspond to 100 metric cubic centimeters, the specific rotations were calculated, using the following modified formula by Browne:

$$[a] = \frac{100\ (a \times 0.3462)}{c \times l}$$

where

a = observed reading (°V.)

c = concentration (grams per 100 cc. solution)

l = length of the observation tube in decimeter

0.3462 = factor for reducing degree Ventzke to angular degree as recently found by the United States Bureau of Standards. (0.34657 is the factor originally given by Browne.)

The calculated specific rotations were compared with the constant specific rotations of pure sugars after making the necessary corrections for concentrations and temperatures of the polarized solutions by using the following formulas given in Browne:

(c = concentration in grams per 100 cc. solution; t = temperature of observation; p = concentration in percentage.)

For sucrose

Concentration (Landolt):

$$[a]_D^{20} = +66.435 + 0.00870c - 0.000235c^2$$

$(c = 0 \text{ to } 65)$

Temperature (Schonrock):

$$[a]_D^t = [a]_D^{20} - 0.0144\ (t-20)$$
$$(t = 12 \text{ to } 25°\text{C.})$$

For invert sugar

Concentration (Cubbe):

$$[a]_D^{20} = -19.447 - 0.06068p + 0.000221p^2.$$
$$(p = 9 \text{ to } 68 \text{ per cent})$$

The concentrations of invert sugar in the solutions polarized were lower than 9 per cent. In the absence of another suitable formula, the above was used, since these results are all approximations.

Temperature (Gubbe):

$$[a]_D^t = [a]_D^{20} + 0.3041\ t-20) + 0.00165\ (t-20)^2$$
$$(t = 0 \text{ to } 30°\text{ C.})$$

For fructose

Concentration and temperature combined (Honig and Jesser.):

$$[a]_D^t = -88.13 - 0.2583p + 0.6714\ (t-20)$$

For galactose

Concentration and temperature combined (Meissl.):

$$[a]_D^t = +83.883 + 0.0785p - 0.209t.$$

For glucose

Concentration (Tollens):

$$[a]_D^{20} = +52.50 + 0.018796p + 0.00051683p^2$$
$$(p = 0 \text{ to } 100 \text{ per cent})$$

Temperature:

No correction is needed as the specific rotation of glucose is almost unaffected by changes in temperature (6).

For raffinose

No corrections were made.

The sugar solutions used in the polarization were evaporated on a water bath and the sugars that were recovered dried again over phosphorous pentoxide and used in the preparations of hydrazones and osazones.

Preparation of hydrazones and osazones of the sugars.—The phenylhydrazones of the sugars were prepared by placing in test tubes mixtures containing one part of the sugar recovered, two parts of phenylhydrazine hydrochloride, three parts sodium acetate, and twenty parts water, and letting the reaction proceed in the cold. The same proportion was used to obtain the phenylosazones, but the test tubes were placed in boiling water until the osazones were completely precipitated.

In the preparation of the parabromophenylosazones the same procedure as for the phenylosazones was followed, except that parabromophenylhydrazine hydrochloride was substituted for phenylhydrazine hydrochloride, and as solvent fifty per cent alcohol was used instead of water.

Purification of the hydrazones and the osazones was done by repeated crystallization in fifty per cent alcohol until the melting points of the products before and after crystallizations remained unchanged. The precipitates were dried by pressing between sheets of filter paper, then heating in an electric oven at about 100° C. for at least four hours and finally storing in a desiccator over phosphorous pentoxide for two or three weeks.

Determination of melting point.—The ordinary capillary-tube method described by Mulliken (7), was closely followed. A 360° rod thermometer, with a diameter of five millimeters and a degree length of 0.85 millimeter, was used and correction for stem exposure was made according to Mulliken's table of stem-exposure corrections.

Polarization before and after inversion.—Aliquot portions of the solutions used in the determination of the specific rotations of the sugars were hydrolyzed with hydrochloric acid, using either the Clerget method (6) or the method adopted by the Association of Official Agricultural Chemists (8), and again polarized. The specific rotations after inversion were calculated as usual and the compound sugar identified by the relations of the specific rotations (before and after inversion). Sucrose, for instance, has a specific rotation of +66.5° at 20° C.; when inverted the rotation becomes —20° which is the specific rotation of invert sugar. As is well known, one part sucrose produces 1.05263 parts of invert sugar (6). This was taken into account in the calculation of the specific rotations after inversion.

Time of phenylosazone precipitation (Mulliken).—In a test tube with an internal diameter of 13 millimeters was placed a mixture of 0.100 gram of the sugar, 0.200 gram of freshly prepared phenylhydrazine hydrochloride, 0.300 gram of crystallized sodium acetate, and 2.00 cubic centimeters of distilled water. The tube was loosely stoppered with a cork stopper and placed in upright position in a beaker containing water, to a height of two or three inches, which was already briskly boiling. The exact moment of immersion was noted, the tube occasionally shaken without removing it from the water, and the time of appearance of the precipitate taken. The character of the precipitate was also noted, whether white, yellow, or orange-yellow, or whether crystalline, flocculent or tending to rise to the surface in oily drops.

RESULTS AND DISCUSSIONS

ISOLATION OF RAFFINOSE

Purification and preliminary examination.—The first method (Zitkowski's) described for the isolation of raffinose was tried four times with the copra meal syrup, and Burkhard's method twice. In each of the six trials the very small amount of product obtained was in the form of a brownish syrupy liquid with a sweetish taste. After standing for over three months no crystals of sugar were formed. All gave positive reaction with Fehling's solution.

As further purifying the syrups separately so that crystallization of sugar would take place was impractical because the amounts were small, it was decided to put them together. Accordingly they were all dissolved in hot water and the resulting solutions combined. The mixture was heated almost to boiling and then treated with crystallized strontium hydroxide. It was then filtered and the residue thoroughly washed with water, then decomposed in aqueous suspension by passing a stream of carbon dioxide. The strontium carbonate was then separated

by filtration and the filtrate evaporated on a water bath to a thin syrup. After purification with alcohol and decolorizing carbon it was evaporated into thick syrup. This was dissolved in boiling 60 per cent alcohol using as little as possible, and then set aside in a desiccator over phosphorous pentoxide. After two days a snow white solid was formed. This was further purified by re-precipitation in 60 per cent alcohol over phosphorous pentoxide. The resulting product was insoluble in absolute alcohol, had a sweetish taste and gave a negative reaction with Fehling's solution.

To dehydrate the material it was placed in an air oven heated at about 60° C. where it began to melt after about four minutes. It was immediately removed from the oven, re-dissolved in boiling 60 per cent alcohol and then re-precipitated in the usual way. The snow white solid produced was carefully dried by placing the material in an air oven and regulating the flame so that it took about two hours to raise the temperature to 60° C which was maintained for two hours. This temperature was gradually raised to about 80° which was maintained for about three hours, then very slowly raised to 100°–105° which was kept for about three hours. The material was finally deposited for three days in a desiccator over phosphorous pentoxide.

Identification.—The final product (about 0.9 gram) was in the form of a white, hygroscopic mass which was insoluble in absolute ethyl alcohol and in ether but soluble in absolute methyl alcohol It had a sweetish taste and melted at 116.4° C., turning dark and finally decomposing a short time after melting.

A solution of the sugar reduced Fehling's solution only after boiling with the latter for about eight minutes.

When 0.7500 gram of the sugar was dissolved in water to make 25 true cubic centimeters of solution (equivalent to 3.00 grams per 100 cubic centimeters of solution) and polarized in a 100-millimeter tube, an average reading of +10.38° Ventzke was obtained at 26° C. The specific rotation was then calculated by the modified Browne's formula as follows:

$$[a]_D^{26} = \frac{100\,(0.3462 \times 10.38)}{3 \times 1} = +119.7852°.$$

Twenty cubic centimeters of the solution used above was hydrolyzed with hydrochloric acid by the Clerget method (6), making up the solution to 25 cubic centimeters (equivalent to 2.4 grams sugar to 100 cubic centimeters of solution). The solution was polarized at 26° C. and an average reading of +4.31° was obtained. The specific rotation was then calculated and found to be +62.1718°.

An attempt was made to study the decomposition products of the sugar by oxidation with nitric acid. Twenty cubic centimeters of the above hydrolyzed solution (this contained 0.48 gram of the original sugar) was heated for about ten minutes on a water bath in order to insure complete hydrolysis of any compound sugars. The solution was neutralized with sodium carbonate, then evaporated almost to dryness, then treated with 30 cubic centimeters of nitric acid (sp. gr. 1.15) and the mixture evaporated on a water bath to about one-third its volume. After standing for 24 hours in the cold, 5 cubic centimeters of water was added and the mixture set aside. The following day, fine white crystals somewhat rhombic or rectangular in form were produced. These were collected in a tared Gooch crucible and washed first with 15 cubic centimeters of cold water,

then with a little alcohol and finally with ether. After drying at about 100° C. for three hours the amount was found to be 0.1159 gram, determined gravimetrically. Subsequent melting point determinations of the crystals were made and an average of 214.20° C. was obtained.

Discussion.—The reducing sugars present in the isolated syrups were impurities, apparently, since the treatment with strontium hydroxide eliminated them from the samples, giving a sugar which did not reduce Fehling's solution.

In the process of dehydration the material melted after four minutes at 60° C., while gradual heating up to 105° did not have any such effect. This was a first indication that the material was raffinose, since this is a characteristic property of this particular sugar when so treated.

The material was decidedly insoluble in absolute ethyl alcohol and in ether but soluble in absolute methyl alcohol and possessed a sweetish taste, properties that in a measure distinguish raffinose from many other sugars. The isolated sugar melted at 116.4° C. (corrected); the constant melting point of raffinose according to Mulliken is 118°–119° C.

The specific rotation of the isolated sugar was +119.7852°. This is 3.4148° lower than the constant specific rotation, +123.2° (uncorrected), of raffinose anhydride but is nevertheless closer to it than to that of any other sugar. The material may not have been very pure although temperature and concentration may have also had some effect. Creydt (6) observed that with increase in temperature there is a slight falling off of the specific rotation of raffinose.

After inversion by the Clerget method a specific rotation of +62.1718° was obtained. This figure approaches the theoretical specific rotation constant +64.1866° (uncorrected)[4] for hydrolyzed raffinose, assuming that raffinose anhydride is hydrolyzed by the Clerget method into 67.86 per cent melibiose and 35.71 per cent fructose according to the following equation:

$$\underset{\text{raffinose}}{C_{18}H_{32}O_{16}} + H_2O = \underset{\text{melibiose}}{C_{12}H_{22}O_{11}} + \underset{\text{d-fructose}}{C_6H_{12}O_6}$$

The oxidation of the hydrolyzed material with nitric acid resulted in the production of a precipitate which gave the properties of mucic acid—in being white, crystalline, rhombic, and having a melting point of 214.2° C. (corrected), which is within the figures for the constant melting point of mucic acid given by Mulliken, these being 212°–215° C. This showed that galactose was probably one of the hydrolysis products of the sugar isolated, which probability also contributed to the possibility of the latter sugar being raffinose.

The amount of mucic acid obtained was 0.1159 gram. If this was formed by the oxidation of galactose it would correspond to (0.1159 × 1.33), or 0.1541 gram of this sugar. This would be $\frac{0.1541}{0.4800} \times 100$ or 32.1042 per cent by weight of the original isolated sugar present in the oxydized solution. If the isolated sugar were raffinose anhydride the theoretical percentage of galactose as obtained by the oxydation into mucic acid would be 35.71 (as compared with the experimental result, 32.1042 per cent), assuming that one molecule of raffinose anhydride produces one molecule each of galactose, glucose, and fructose on complete hydrolysis.

[4] The 67.86 per cent melibiose anhydride would give a rotation of 0.6786 × +143 = +97.0398; the 35.71 per cent of fructose would give a rotation of 0.3571 × −92 = −32.8532. The combination of those effects would be +97.0398 − 32.8532 = +64.1866.

It will be noted that in all of the above determinations the figures obtained for the isolated sugar were a little lower than the theoretical figures for raffinose as given in the literature. Nevertheless, all the evidences obtained point to the conclusion that the sugar isolated was raffinose. It is very probable that the material was not as completely dehydrated as it was thought to be.

ISOLATION OF SUCROSE

The sugar isolated by the use of barium hydroxide and zinc sulphate (Method "a") was in the form of large, white crystals, very soluble in water and aqueous solutions of ethyl alcohol and had a sweet taste.

When 0.8 gram of the sugar was dissolved in water to make 25 true cubic centimeters of solution (equivalent to 3.2 grams of sugar to 100 true cubic centimeters of solution) and polarized in a 100-millimeter tube, it gave an average reading of +6.12 at 25° C. Calculating the specific rotation by the modified Browne's formula, we have

$$[a]_D^{25} = \frac{100\ (0.3462 \times 6.12)}{3.2 \times 1} = +66.2108°$$

which closely approaches the constant specific rotation of sucrose, +66.3883°, after correcting for temperature and concentration.

When 10 cubic centimeters of the above solution was inverted with hydrochloric acid and made up to 25 cubic centimeters (corresponding to 1.28 grams of sucrose or 1.3474 grams of invert sugar to 100 cubic centimeters of solution) and polarized as before, it gave an average reading of —0.70° at 25° C. Calculating,

$$[a]_D^{25} = \frac{100\ (0.3462 \times -0.70)}{1.3474 \times 1} = -17.9858°$$

This approximates the corrected constant specific rotation of invert sugar, —17.9666°.

Steffen's method (Method "b") gave a sugar which was similar in properties to the first one. Six-tenths gram of the sugar dissolved to 25 cubic centimeters of solution, when polarized as above, gave an average reading, of +4.55°; 10 cubic centimeters of the solution, when inverted with hydrochloric acid as usual, gave a reading —0.55°. Calculating, we obtain a specific rotation of +65.6338° before inversion and —18.8431 after the inversion. The results closely agree with the corrected specific rotations, +66.3825° and —17.9463°, of sucrose and invert sugar, respectively.

It will be seen that the specific rotations of invert sugar from the two sugar samples were slightly higher than the corresponding constants for invert sugar, corrected for concentration and temperature. This may be explained by the finding of Hammerschmidt (6) that the presence of hydrochloric acid in solution increases the specific rotation of invert sugar.

Neither sugar preparations reduced Fehling's solution after heating for 5 minutes.

The foregoing results afford conclusive proof that both sugar preparations were sucrose. This confirms the previous findings of the writer (see Table I) and of other investigators. Van Kampen (9), for instance, gave 17.5 per cent as the sucrose content of copra meal, determined by polarization. Bodmer (10)

analysed four samples of copra and found sucrose ranging from 0.95 per cent to 7.71 per cent. A report was made by Bourquelot (11) of an analysis of a crude sugar sold in India which was made from *Cocos nucifera*. This contained about 75 per cent sucrose although it was not stated from which part of the coconut the sugar was obtained.

ISOLATION OF D-FRUCTOSE

Two samples of sugar were isolated by the method described for the isolation of fructose. Both preparations were in the form of white solid or hygroscopic crystals, soluble in water and aqueous solutions of alcohol but nearly insoluble in 100 per cent alcohol.

The specific rotations of the two preparations were as follows:

	I	II
Grams sugar in 100 cc. solution	6.4000	1.0000
Av. reading: °V. at 25° C.	—16.2300	— 2.4500
$[a]_D^{25}$ Calculated	—87.7941°	—84.8190°
$[a]_D^{25}$ For fructose (corrected)	—86.4261°	—85.0313°
Difference	+ 1.3680°	— 0.2120°

The first sugar gave a specific rotation of —87.7941° at 25° C. This is 1.3680° higher than the constant specific rotation of d-fructose (—86.4261°) corrected for temperature and concentration. For the second sugar the specific rotation found was —84.8190° which is only 0.2120° lower than the corrected constant (—85.0313°) for d-fructose.

The following comparison of the results of other determinations and the respective constants for d-fructose shows further that the preparations contained d-fructose:

	Constants for d-fructose.	*Found.*
M. p. of the sugar	95°–105° C.	99.4°, 107.3° C.
Time of phenylosazone separation	2 min.	2 min. 8 sec. 3 min.
M. p. of phenylosazone	204°–205° C.	201.9°, 205.3° C.
M. p. of para-bromophenylosazone	*224.0°* C.[a]	218.6°, 221.9° C.

a The figure in italics was obtained by actual determination, using pure fructose, and is but tentative.

The isolated sugars melted at 99.4° and 107.3° C., comparing very favorably with the constant melting point (95–105° C.) of d-fructose. The periods of time required for the separation of phenylosazones were 2 minutes 8 seconds and 3 minutes; the standard time for d-fructose is 2 minutes according to Mulliken. The phenylosazones melted at 201.9° and 205.3° C., figures that are very close to the constant (204–205° C.) for d-fructose. The parabromophenylosazones had melting points of 218.6° and 221.9° C. which are a little lower than the average melting point (224° C.) of the parabromophenylosazone prepared from pure d-fructose.

The phenylosazones of the two sugars (see Plate I, figs. 1 and 2) were in the form of yellow, broom-shaped crystals. Plate I, fig. 3, shows the parabromophenylosazone crystals. They were in the form of yellowish, long needles which were arranged in bunches which oftentimes radiated from a central nucleus.

The writer tried several times to prepare the phenylhydrazone of the sugars by the method already described for its preparation (see "Methods of Identification") but each trial resulted in the production of the phenylosazone as shown by the melting point which usually was approximately equal to 204–205° C., the constant for fructose-phenylosazone. The crystals prepared under this condition, however, were different from the crystals prepared by the application of heat in that they were much smaller and of a moss-like appearance (see Plate I, fig. 4). Hofman (12) prepared the phenylosazones of many sugars but also failed to produce fructose-phenylhydrazone.

The above results confirm the previous finding of the writer that fructose was present in copra meal. Weehuizen (13) noted that coconut milk contains either a ketohexose or a bisucrose which yields a ketohexose, but a question arises as to whether by "coconut milk" the author meant the water of the coconut found inside the nut or the milk expressed from the meat of the coconut.

ISOLATION OF D-GALACTOSE AND D-GLUCOSE BY THE PHENYLHYDRAZONE METHOD

Table II summarizes the results of the isolation of reducing sugars by the phenylhydrazone precipitation and the study of their properties. The first column shows the number of the fractions of the hydrazones. The date and time of filtrations (second column) give an idea as to the relative time of formation of the hydrazones. Forty-one fractions in all were collected and the precipitation of the hydrazones continued for over six weeks, the date of last filtration being November 19.

In fractions 1 and 2 and from 29 to 41 the amounts of precipitate collected were so small that it was found impractical to recover any sugars from them. In some cases the preparations were spoiled, and so were not included in the table.

Fractions 8 to 17 all gave good yields of yellow precipitate which, however, when treated with hydrochloric acid in the usual way did not produce any sugar. Portions of the precipitates were purified by re-crystallization in alcohol. The purified products gave melting points which were close to the melting point of glucose-phenylosazone or fructose-phenylosazone. Since fructose ordinarily yields the phenylosazone instead of the phenylhydrazone (12) it is very likely that these portions contain fructose, the presence of which in copra meal has been verified by a different method of isolation, as described above.

It was not possible to isolate the sugars from most of the fractions in solid or crystalline form, as only small amounts of the hydrazones could be collected.

Solid or crystalline sugars were recovered from fractions 5, 6, 7, 19, 20, 21, and 22. Because of the small amounts of the sugars obtained it was possible to determine the specific rotations only for fractions 5, 6, 19, 20, and 21. The time of osazone separation was determined for these fractions as well as for fraction 22.

TABLE II.—*Summary of results of isolation of reducing sugars by phenylhydrazone method and the identification of the sugars.*

Fractions of hydrazone No.	Date and time of filtration.	Physical properties of the recovered preparations.	Specific rotation. $[a]_D^{25}$	Time of phenylosazone separation and color of precipitate.	Melting point in °C. of			Possible sugar isolated.
					Phenylhydrazone.	Phenylosazone.	P-Bromophenylosazone.	
	1923							
3	Oct. 2—6 p. m.	brownish syrup	——	——	159.6	——	——	——
4	Oct. 3—8 a. m.	brownish syrup	——	——	161.2	189.9	——	galactose
5	Oct. 3—4 p. m.	fine, white crystals m. p. 159.8° C.	+77.8950	16 min. 19 sec. yellow	156.7	186.1	——	galactose
6	Oct. 4—8 a. m.	fine, white crystals m. p. 157.5	+79.0105	18 min. 4 sec. yellow	160.0	181.4	——	galactose
7	Oct. 4—6 p. m.	fine, white crystals m. p. 163.8	——	——	158.4	146.3	——	galactose
8–17	——	No sugar could be recovered	——	——	——	——	——	——
18	Oct. 17—8 a. m.	brownish syrup	——	——	157.9	205.4	225.6	glucose
19	Oct. 18—8 a. m.	white, noncrystalline solid m. p. 145.2°C.	+49.1373	5 min. 12 sec. yellow	161.4	198.8	223.4	glucose
20	Oct. 20—8 a. m.	white, noncrystalline solid m. p. 138.1°C.	+51.9300	5 min. 8 sec. yellow	158.2	204.7	224.1	glucose
21	Oct. 21—8 a. m.	white, noncrystalline solid m. p. 147.3°C.	+52.0279	4 min. 37 sec. yellow	159.1	207.3	221.7	glucose
22	Oct. 23—4 p. m.	white, noncrystalline solid m. p. 142.8°C.	——	5 min. 27 sec. yellow	157.7	203.7	——	glucose
23–25	——	brownish syrup	——	——	159.4	198.6	223.0	glucose
26–28	——	brownish syrup	——	——	——	202.3	——	?
29–33	——	brownish syrup	——	——	——	——	——	?
34–41	Last filtration. Nov. 19	brownish syrup	——	——	——	——	——	?

The isolated sugars were polarized for the determination of their specific rotations. Aliquot portions of the solutions were treated with acid as in sucrose hydrolysis to test for the presence of compound-sugars. Hydrolysis had no appreciable effect on the specific rotations of the preparations, showing that they contained simple sugars. They were found to be d-galactose and d-glucose.

D-Galactose.—Fractions 5, 6, and 7 gave sugars of similar physical properties. They were all in the form of fine white or colorless crystals which were soluble in water and aqueous solutions of alcohol but insoluble in absolute ethyl alcohol.

The following give their specific rotations compared with those corresponding to d-galactose after applying corrections for concentration and temperature.

	I	II
Grams sugar per 100 cc. solution	2.0000	3.6000
Av. reading, °V. at 25° C.	+4.5000	+8.2160
$[a]_D^{25}$ Calculated	+77.8950°	+79.0105°
$[a]_D^{25}$ For d-galactose (corrected)	+78.8150°	+78.9406°
Difference	—0.9200°	+0.0699°

The first sample had a specific rotation of +77.8950° at 25° C. which is 0.9200° lower than the constant (+78.8150°) for d-galactose corrected for concentration and temperature. Sample II gave a specific rotation which was very slightly (0.0699°) higher than the corrected constant for d-galactose.

Plate I, figure 5, shows the phenylhydrazone crystals prepared from fraction 5. They were in the form of yellowish fine needles arranged in bunches which vary from broom-shaped to a circular form, the crystals radiating from a central nucleus. The phenylosazones prepared from fractions 5, 6 and 7 are shown in Plate II, figs. 1, 2, and 3. They were all similar to one another, all being yellowish and in the form of crystals which are more or less circular, with rays radiating from a thick central nucleus.

The following comparison will also prove that the sugars isolated were d-galactose (see Table II for figures in the second column):

	Constants for d-galactose.	*Found.*
Melting point of the sugar	165° C.	157.3°, 163.8° C.
Time of phenylosazone separation	15-19 min.	16 min. 19 sec., 18 min. 4 sec.
Melting point of phenylhydrazone	158° C.	156.7°, 160.0° C.
Melting point of phenylosazone	188°–191° C. 196°–197° C.	186.1°, 184.4° C.

Pure galactose anhydride has a melting point of about 165° C.; the isolated sugar melted at 157.3° and 163.8° C. The periods of time for separation of phenylosazones found were 16 minutes 19 seconds and 18 minutes 4 seconds, both well within 15 to 19 minutes, the time for the d-galactose compound given by Mulliken. The phenylhydrazones melted at 156.7° and 160.0° C., both of which approximate 158° C., the constant given for that compound. The phenyl-

osazones had melting points which are a little lower than the constants for d-galactose as given by Browne but are closer to the latter than to that of any other sugars.

No parabromophenylosazones were produced from fractions 3 to 8 (see Table II) in spite of the efforts to produce them from the recovered sugars. To find out if this was true with galactose the writer tried to prepare the parabromophenylosazone by the method used in this particular work, using pure samples of the sugar. It was only with difficulty that small amounts of precipitate were produced which, however, was decomposed during the process of drying in the electric oven.

The above results all point to the presence of galactose and confirm the previous report of the writer (2) that galactose is present in copra meal.

D-Glucose.—Fractions 19, 20, 21, and 22 gave sugars of similar properties. They were all in the form of a white non-crystalline solid, soluble in water and aqueous solutions of alcohol but almost insoluble in absolute alcohol.

The specific rotations of the sugars obtained from three of the fractions (see Table II) were determined. For this purpose 0.3000 gram of each of the sugars dissolved to 25 cubic centimeters of solution was used. The following table shows the results obtained compared with the corrected constants for d-glucose:

	I	II	III
Grams sugar to 100 cc. solution	1.2000	1.2000	1.2000
Av. reading, °V. at 25° C.	+1.7032	+1.8000	+1.8034
$[a]_D^{25}$ Calculated	+49.1373°	+51.9300°	+52.0279°
$[a]_D^{25}$ For d-glucose	+52.5233°	+52.5233°	+52.5233°
Difference	—3.3860°	—0.5933°	—0.4954°

With the exception of sample I the sugars isolated gave specific rotations which were close to the corrected constants for d-glucose. It is very probable that sugar I was not so pure as the other samples. The average specific rotation of the three sugars will be found to be +51.0317 which is 1.4915° lower than the corrected specific rotation of d-glucose, +52.5233°.

The phenylhydrazone of the sugars isolated from fractions 20 and 21 (see Plate II, figs. 4 and 5) were in the form of greenish-yellow crystals which were more or less circular and which, in many cases, had well-defined spine-like rays radiating from the thick central part. The phenylosazones of the sugars from fractions 19 and 21 (see Plate II, fig. 6, and Plate III, fig. 1) were similar, both being in the form of yellowish broom-shaped crystals. The parabromophenylosazones of the sugars isolated from fractions 20 and 21 (see Plate III, fig. 2) were both in the form of yellowish needles arranged in bundles which in many cases appeared to have a central nucleus.

The following comparison of the results of other determinations (see Table II) and the different constants for d-glucose also shows that the three sugar samples were all d-glucose:

	Constants for d-glucose.	*Found.*
M. p. of the sugars	146–147° C.	138.1° to 147.3° C.
Time of phenylosazone separation	4–5 minutes	4 min. 37 sec. to 5 min. 27 sec.
M. p. of phenylhydrazone	159–160° C.	157.7° to 161.4° C.
M. p. of phenylosazones	204–205° C.	198.8° to 207.3° C.
M. p. p-bromophenylosazone	222° C.	221.7° to 224.1° C.

The sugars isolated had melting points of from 138.1° to 147.3° C. which very closely agree with the constant melting point of d-glucose, 146–147° C. The time of phenylosazone separation ranged from 4 minutes and 37 seconds to 5 minutes and 27 seconds as against 4–5 minutes, the standard time for d-glucose. As may be seen, the melting points of the phenylhydrazones, phenylosazones, and parabromophenylosazones of the recovered sugars compare very favorably with the respective constants for those of d-glucose. D-fructose and d-mannose ought to give the same osazones, but the data for specific rotations, time of phenylosazone separation, and the melting points of the sugars themselves and of their phenylhydrazones, show that the sugar isolated from the different fractions could have been neither fructose nor mannose, hence it was most likely glucose.

SUMMARY OF RESULTS FOR COPRA MEAL

Five different sugars were isolated from copra meal; namely, raffinose, sucrose, fructose, galactose, and glucose.

COCONUT WATER

As early as 1906 Dunstan (14), working in Ceylon, analyzed the water in the coconut (sometimes called coconut milk) and reported the results of his work as follows: water, 96 per cent; ash, 0.5 per cent; mannitol, 1.8 per cent; cane sugar, 0.1 per cent; glucose, 0.9 per cent; acid constituents, 0.48 per cent. In another sample of water from ripe coconuts he found 2.6 per cent of cane sugar, 0.5 per cent of glucose, but no mannitol.

At about the same time De Kruyff (15) in the East Indies, in the course of a study of the industrial value of coconut water, found that it contained saccharose which was inverted as the nut matured by a diastase which was secreted by the cells of the endosperm. The author also reported the presence of oxydase and catalase which, however, were not found in the immature fruit. The haustorium was found to contain also lipase, a proteolytic diastase, amylase, catalase and a peroxydase. Two years later, in 1908, the same investigator (16) confirmed the above results of his own work.

Behre (17) polarized three samples of milk from Ceylon coconuts and obtained the following results, using a 200-millimeter tube:

	I	II	III
Before inversion	+5° 10 min.	+4° 2 min.	+3° 28 min.
After inversion	—2° 25 min.	—2° 1 min.	—1° 8 min.

The solid portion of the milk is said to have consisted principally of cane sugar.

In 1914 Gonzalez (18), working in this laboratory on the changes occurring in the ripening coconut, found that in the early stages of the growth of the nut there was an accumulation of invert sugar and amino acids in the milk. During the middle period of growth he detected the presence of sucrose.

Roxas (19), also of this laboratory, found that during the germination of the nuts small amounts of lipase occur in the water and the inner surface of the endosperm and is abundant in the outer part of the foot or haustorium.

A year later (1915) Vista (20), working also in this laboratory, confirmed the findings of Gonzalez and further concluded that when the nuts germinate the percentages of sucrose and invert sugar in both the milk and meat increase rapidly.

Leonard (21) claims that coconut water when fermented for 4 or 5 days is a good coagulating agent for latex and will produce better rubber than will crude acetic acid or the cacao fermentation acid treatment.

In 1917 Wallace (22) analyzed coconut milk and found that it contained $1^1/_5$ grams acid per ounce, 0.87 per cent sugar, 0.16 per cent sodium chloride, 0.23 per cent P_2O_5, and traces of iron. He believed that, when properly seasoned, coconut water might be used in the diet of the sick.

Quite recently (1920) Weehuizen (13) reported that in the Dutch Indies milk is sometimes adulterated with coconut milk. This, he claimed, may be detected by testing for sucrose with hydrochloric acid and resorcinol. In this connection he noted that coconut milk contained either a ketohexose or a bisucrose which yielded a ketohexose.

From the above reports it will be seen that coconut water is supposed to contain sugars, possibly of different kinds. As with copra meal, it was the aim in the present work to isolate some of these sugars and definitely to establish their identity.

MATERIAL AND METHODS

PREPARATION OF SUGAR SYRUP FROM COCONUT WATER

The water obtained from the 150 coconuts used in the preparation of copra described in the first part of this paper was collected. After neutralizing with sodium carbonate and filtering out any precipitate, the water was evaporated to a small volume under reduced pressure. It was then poured into 95 per cent alcohol previously neutralized with sodium carbonate; more neutral alcohol was added as needed until a permanent precipitate was produced. After filtration, the clear liquid was decolorized with powdered bone black and then evaporated *in vacuo* to a thick syrup. This was used for the isolation of the different sugars.

METHODS OF ANALYSIS

Before proceeding to the isolation of the sugars a preliminary examination of the syrup prepared from coconut water was made.

The syrup reduced Fehling's solution showing that reducing sugars were present. Double polarization of the substance was tried a number of times, using the method adopted by the Association of Official Agricultural Chemists (8) and the results indicated the probable presence of about 12 per cent[5] of compound

[5] This figure, of course, could not be taken as the true amount of sucrose or other compound sugars in the coconut water used, as inversion might have taken place during the process of evaporation.

sugar calculated as sucrose. From these preliminary experiments an idea was obtained of the probable presence of both reducing and non-reducing sugars in the material to be analysed.

Exactly the same procedures, as for the copra meal syrup, were followed in the isolation and identification of reducing and non-reducing sugars from the syrup prepared from coconut water.

RESULTS AND DISCUSSIONS

No raffinose could be isolated by either of the methods described for raffinose. In the lead-oxide method no syrup was obtained after evaporating the mother liquor which resulted after passing carbon dioxide through the lead-oxide residue suspended in water. In the Burkhard method very little precipitate was formed when the solution obtained after evaporating the methyl alcohol was treated with strontium hydroxide. The solution after passing carbon dioxide, when evaporated, gave a brownish opaque residue which reduced Fehling's solution, too small to produce any sugar by the usual method of purification.

On the other hand, samples of sugars were obtained by the methods described for sucrose and fructose and by the phenylhydrazone isolation method.

ISOLATION OF SUCROSE

Three samples of pure sugar were obtained from the coconut-water syrup by the use of Steffen's method (Method "b") for the isolation of sucrose. They were all in the form of large white crystals which were very soluble in water and aqueous solutions of alcohol and slightly soluble in absolute ethyl alcohol. All of them reduced Fehling's solution only after boiling for about 7 minutes.

In the determination of their specific rotations, 0.6000 gram of each was taken, dissolved in water to make 25 cubic centimeters of solution and polarized in a 100-millimeter tube at 25° C., using a quartz-wedge Ventzke scale saccharimeter. Ten cubic centimeters of the above solution was inverted with hydrochloric acid in the usual way, then made up to 25 true cubic centimeters and polarized as before. The following readings were obtained at 25° C.:

	I	II	III
Before inversion °V. (average)	+4.52	+4.50	+4.54
After inversion °V. (average)	—0.56	—0.54	—0.58

The calculated specific rotations were as follows:

	I	II	III	*Average*
Before inversion	+65.2010°	+64.9125°	+65.4895°	+65.2010
After inversion	—19.1857°	—18.5002°	—19.8704°	—19.1521°

The above figures show that the three preparations probably contained the same sugar, as the corresponding values are almost identical. The average specific rotation is +65.2010° which is only 1.1815° lower than the constant specific rotation of sucrose +66.3825°, corrected for temperature (25° C.) and concentration.

The average specific rotation after inversion is —19.1521°. This approximates the constant specific rotation of invert sugar (—17.9463°) after making the necessary corrections for temperature and concentration.

The above results furnish sufficient proof for the identity of the sugar present in the preparations. Dunstan (14), Behre (17), Wechuizen (13) and other investigators reported the presence of sucrose in coconut water and the results of the present investigation confirm the findings of these investigators. Kruyff (15) claims that the sucrose is inverted as the nut matures by a diastase secreted by the albumin cells; the stage of maturity of the nuts used in his experiments is not specified in the literature. Kruyff's results are contrary to those of Vista (20) who found sucrose in coconut water at the stage of maturity and even up to the point of germination when sucrose and invert sugar increased rapidly. Dunstan (14) also found sucrose (2.6 per cent) in a sample of water from ripe coconuts.

ISOLATION OF D-FRUCTOSE

Two preparations were obtained following the method described for the isolation of fructose. These two preparations were identical in almost all respects to those obtained from copra meal by the same method, especially in form and solubility.

The following tabulation gives the specific rotations of these preparations compared with the corrected constants for d-fructose:

	I	II
Grams sugar per 100 cc. solution	7.2000	4.0000
Av. reading, °V. at 25° C.	—18.0342°	—10.0190°
$[a]_D^{25}$ Calculated	—86.7144°	—86.7144°
$[a]_D^{25}$ For d-fructose (corrected)	—86.6328°	—85.8062°
Difference	+0.0816°	+0.9082°

The first sugar had a specific rotation of —86.7144° which very nearly equals the corrected constant (—86.6328°) for d-fructose, the difference being only 0.0816°. Sugar number II had a specific rotation (—86.7144°) which is 0.9082 higher than the corrected rotation (—85.8062°) of d-fructose.

Plate III, figure 3, shows the phenylosazone of sugar number I. The crystals were needle-shaped, arranged in bundles in most cases and radiating from a central nucleus.

The results of other determinations are as follows:

	I	II	*Average*
M. p. of the sugar	87.3° C.	92.3° C.	89.8° C.
Time of osazone separation	3 min 2 sec.	2 min. 52 sec.	2 min. 57 sec.
M. p. of phenylosazone	207.7° C.	203.8° C.	205.75° C.
M. p. of parabromophenylosazone	226.3° C.	221.6° C.	223.95° C.

The average melting point of the sugars was 89.8° C. which is lower than the constant melting point of d-fructose, 95–105° C. The average time required for the separation of the phenylosazone was 2 minutes and 57 seconds, the constant for d-fructose being 2 minutes. The melting point of the phenylosazones was on the average 205.75° C., which compares very favorably with the constant 204–205° C., for d-fructose. The average melting point of the parabromophenyl-

osazones was 223.95° C.; that for d-fructose parabromophenylosazone which was previously prepared for the purpose of comparison was 224.0° C.

As in the case of d-fructose isolated from copra meal, all efforts to produce the phenylhydrazone resulted in the formation of the phenylosazone as shown by the melting point of the product.

The foregoing results give sufficient evidence that the preparations both contained d-fructose. If sucrose is really present in coconut water, as was shown by the analysis for sucrose, it is easy enough to explain why fructose (incidentally glucose too) should also be present. This result is in accord with the claim of Weehuizen (13) that a ketohexose is present in coconut water.

ISOLATION OF D-GLUCOSE BY THE PHENYLHYDRAZONE METHOD

About 30 grams of the syrup obtained from coconut water were used in the preparation of phenylhydrazones, and filtrations were made daily. Twenty-two fractions, in all, of the precipitate were collected.

After having considered the isolation of d-fructose, it is interesting to note that the first 11 fractions of the precipitate gave no sugars at all. Purified portions of the fractions gave melting points which suggested that they were osazones of fructose, glucose or mannose; in this particular case it was possibly fructose since, as has already been noted, this sugar ordinarily does not form the phenylhydrazone.

Pure crystalline sugars which furnished sufficient material for complete identification were obtained from only three of the fractions (fractions 13, 15 and 16); the rest of the fractions gave only brownish syrups which were too meager to permit of identification, or in many cases gave none at all.

The three samples of sugar which were isolated were identical to one another in most respects, being all in the form of white solid, soluble in water and aqueous solutions of alcohol and insoluble or almost insoluble in absolute ethyl alcohol.

To determine their specific rotations 0.5000 gram of each was dissolved in water to make 25 true cubic centimeters of solution. This was polarized as before. The following are the results obtained at 25° C. compared with the corrected constants for d-glucose:

	I	II	III
Av. reading °V	+3.0057	+2.9055	+2.9255
$[a]_D^{25}$ Calculated	+52.0287°	+50.2942°	+50.6404°
$[a]_D^{25}$ For d-glucose (corrected)	+52.5397°	+52.5397°	+52.5397°
Difference	—0.5110°	—2.2455°	—1.8993°

The specific rotations of the three sugars were, respectively, +52.0287°, +50.2942° and +50.6404°. These are, respectively, 0.5110°, 2.2455° and 1.8993° lower than the corrected constant (+52.5397°) for d-glucose and are closer to the latter than to those of any other sugars.

The phenylosazone of sample 3 is in the form of yellowish crystals which formed circular groups with a thick central nucleus. The phenylosazone of the same sample was in the form of long yellowish needles grouped together in a broom-like body. The parabromophenylosazones of samples 2 and 3 are shown in Plate III, fig. 5 and 6. They are both in the form of yellow needles arranged in bundles which appear to form a central nucleus.

The following tabulation shows other properties of the preparations and the melting points of their hydrazones and osazones:

	I	II	III
M. p. of the sugars	139.8° C.	142.6° C.	144.7° C.
Time of osazone separation	6 min. 2 sec.	5 min. 4 sec.	4 min. 36 sec.
M. p. of phenylhydrazones	158.3° C.	156.3° C.	162.2° C.
M. p. of phenylosazone	206.6° C.	202.8° C.	207.0° C.
M. p. of parabromophenylosazone	223.8° C.	221.9° C.	——

An examination of the above figures will show that the three sugars isolated were probably of the same kind, as the corresponding figures for the three samples closely agree. The following comparison of the average figures for the three sugars and the respective constants for d-glucose will further show that the sugars isolated were d-glucose:

	Averages of the 3 samples.	*Constants for d-glucose.*
M. p. of the sugars	142.4° C.	146–147° C.
Time of osazone separation	5 min. 14 sec.	4–5 min.
M. p. of phenylhydrazone	158.9° C.	159–160° C.
M. p. of phenylosazone	205.5° C.	204–205° C.
M. p. of parabromophenylosazone	222.85° C.	222° C.

The average melting point of the three sugars isolated was 142.4° C. This is a little lower than the constant melting point, 146-147° C. of d-fructose. As may be seen from the above comparison, the average figures for the time of phenylosazone separation, and the melting point of phenylhydrazones, phenylosazones and parabromophenylosazones, agree pretty closely with the respective constants for d-glucose.

From all these data it is evident that the three fractions contained one sugar, d-glucose. This confirms the results of Dunstan (14) who reported the presence of 0.5 per cent of glucose in a sample of water obtained from ripe coconuts.

SUMMARY OF RESULTS FOR COCONUT WATER

Three different sugars were isolated from coconut water. These are sucrose, fructose, and glucose.

GENERAL SUMMARY

Fresh copra meal obtained from 150 ripe coconuts was freed from oil and extracted completely with hot water. From the extract a sugar syrup was prepared. The sugars in this syrup were isolated and identified.

The water from the same 150 coconuts was evaporated to a syrup and analyzed in the same way as the copra meal syrup.

The methods of extraction of the sugars and of the preparation of the syrups, the procedures used in the isolation of the individual sugar, and the methods of identification are described. The results are discussed.

The following sugars were isolated and identified:

From copra meal,—raffinose, sucrose, fructose, galactose, glucose.

From coconut water,—sucrose, fructose, glucose.

ACKNOWLEDGMENT

The writer is under obligation to Dr. Manuel Luz Roxas, Professor of Agricultural Chemistry, under whose direction the work was undertaken, for suggesting the subject and for help in the preparation of the paper. The photomicrographs of the sugar derivatives were made through the courtesy of the Philippine Bureau of Science.

Thanks are also due Dr. Francisco A. Quisumbing, Assistant Professor of Chemistry, College of Liberal Arts, University of the Philippines, for reading the paper and for suggestions and criticisms.

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ILLUSTRATIONS

Plate I

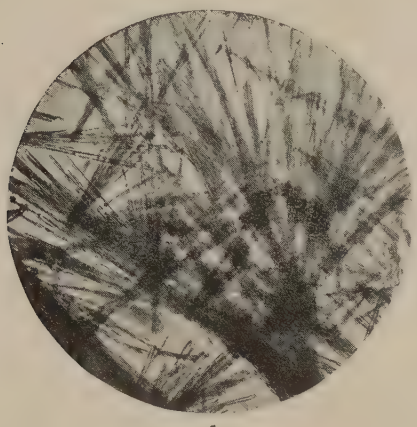
Fig. 1. Phenylosazone of sugar No. I isolated from copra meal. (Fructose)
2. Phenylosazone of sugar No. II isolated from copra meal. (Fructose)
3. Parabromophenylosazone of sugar No. I isolated from copra meal (Fructose)
4. Phenylhydrazine derivative (prepared in the cold) of sugar No. I isolated from copra meal. (Fructose)
5. Phenylhydrazone of sugar isolated from fraction 5 from copra meal (Galactose)

Plate II

Fig. 1. Phenylosazone of the sugar isolated from fraction 5 from copra meal (Galactose)
2. Phenylosazone of the sugar isolated from fraction 6 from copra meal (Galactose)
3. Phenylosazone of the sugar isolated from fraction 7 from copra meal (Galactose)
4. Phenylhydrazone of the sugar isolated from fraction 20 from copra meal (Glucose)
5. Phenylhydrazone of the sugar isolated from fraction 21 from copra meal (Glucose)
6. Phenylosazone of the sugar isolated from fraction 19 from copra meal (Glucose)

Plate III

Fig. 1. Phenylosazone of the sugar isolated from fraction 21 from copra meal (Glucose)
2. Parabromophenylosazone of the sugar isolated from fraction 21 from copra meal (Glucose)
3. Phenylosazone of sugar No. I. isolated from coconut water (Fructose).
4. Parabromophenylosazone of sugar No. II isolated from coconut water. (Fructose)
5. Parabromophenylosazone of sugar No. II isolated from fraction 15 from coconut water. (Glucose)
6. Parabromophenylosazone of sugar No. III isolated from fraction 16 from coconut water (Glucose)



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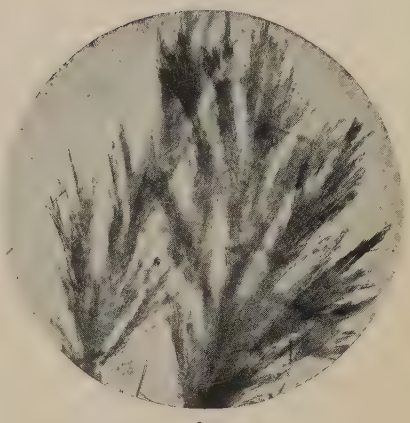

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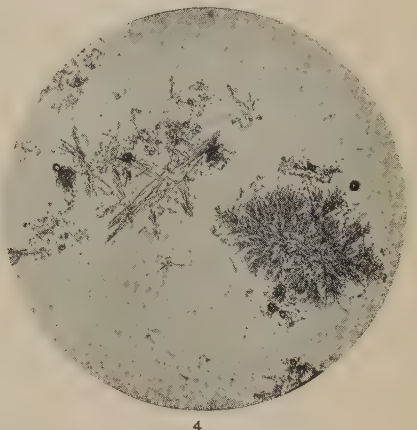

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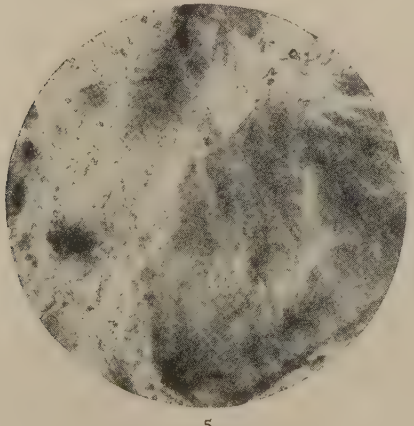

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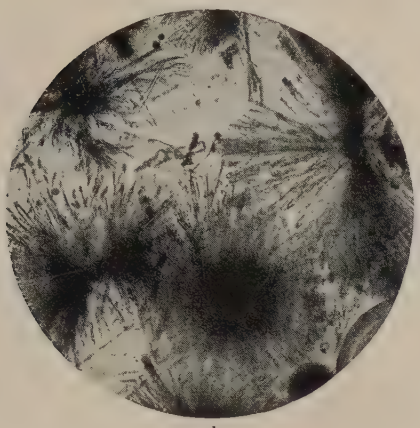

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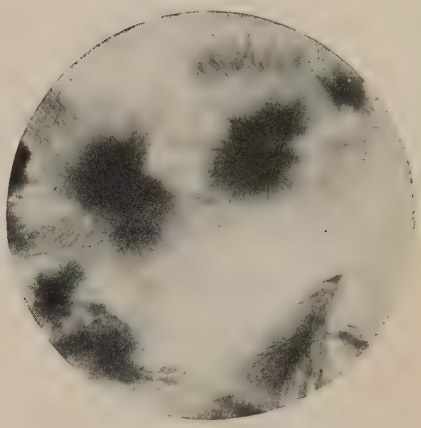

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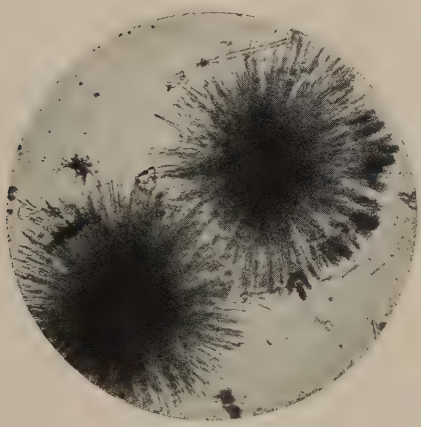

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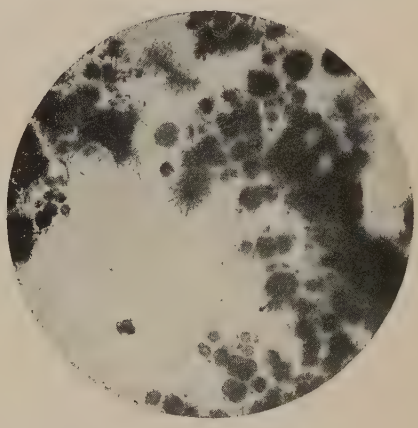

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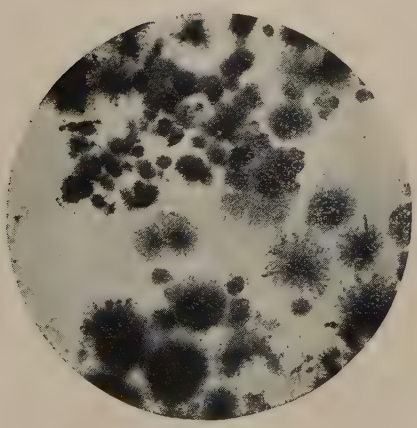

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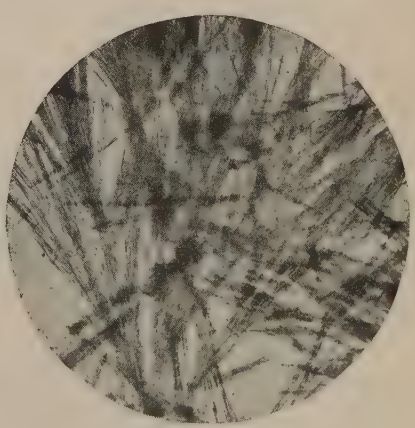

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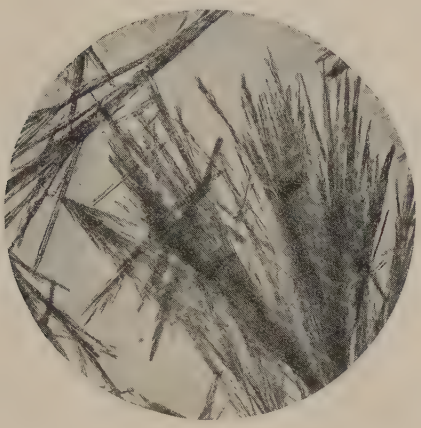
PLATE II



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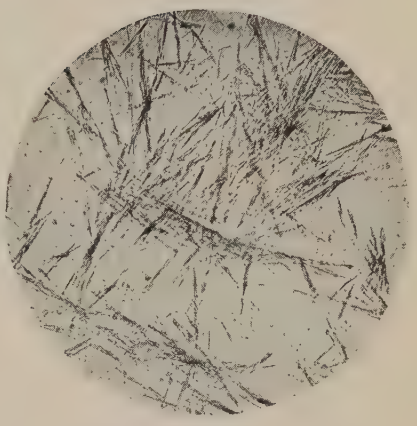

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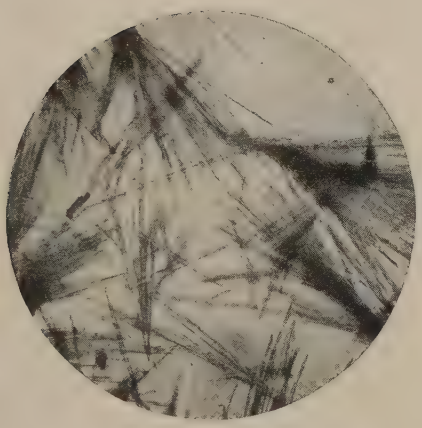

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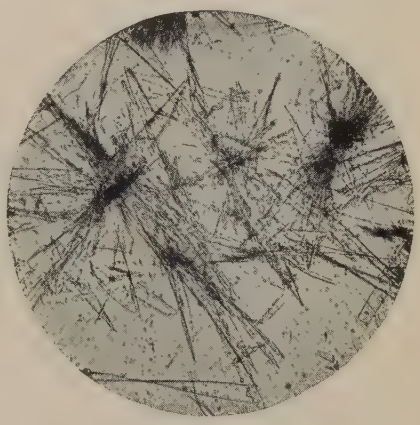

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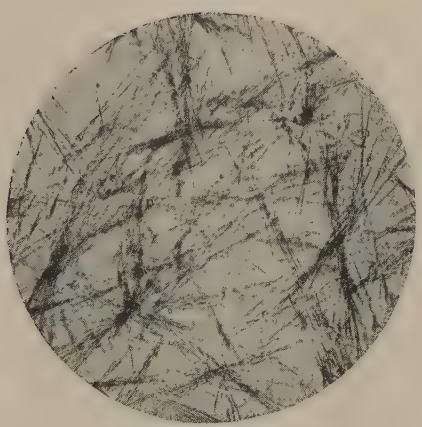

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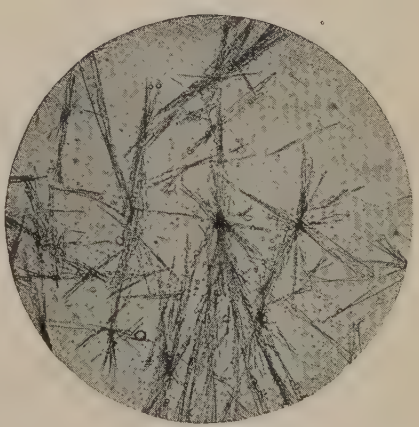

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PLATE III

RICE BRAN, CORN, AND COPRA MEAL AS SUPPLEMENTS TO CAMOTE VINES FOR GROWING PIGS[1]

By Teofilo P. Allas

Camote (*Ipomoea batatas*) can be extensively grown as a forage crop in the Philippines for it thrives in both the valleys and the regions of high altitudes. As it can stand close grazing and trampling because of its quick growth, it is better for forage than many other crops. Pigs relish it, consuming both leaves and tubers.

Among the local feeds, corn, rice bran, and copra meal are the most easily obtained. Corn is widely grown in the Islands. Rice bran composed principally of the layer of the rice grain lying just under the hull is the by-product of rice mills, and is available at low prices in rice growing regions. Copra meal is the ground cake obtained after the oil is extracted from copra. It is a by-product which has become abundant since the establishment of numerous oil mills.

The following experiments with the object of testing the comparative value of rice bran, corn, and copra meal as supplement to camote for growing pigs were conducted at the College of Agriculture during the College year, 1920-1921.

MATERIALS AND METHODS

The study was made on twelve native pigs secured from the barrio of San Antonio, Los Baños. The pigs were practically the same in size and each four came from three different litters, farrowed about the same time.

The pigs were fed morning and afternoon with a mixture of shelled corn and rice bran. During the first week after weaning, they were given a small amount of milk in addition to the concentrate ration. A mixture of corncob charcoal, salt, lime, and wood ash was accessible most of the time. The following is the proportion by weight of the mixture:

Charcoal	75 parts
Salt	10 parts
Lime	10 parts
Wood ash	5 parts

The pigs were given daily all the camote vines they would consume.

On July 17, the male pigs were castrated. Three lots of a hog house, with paddocks adjoining, were set aside for the experiment. Feeding troughs were provided in each lot.

EXPERIMENTS AND RESULTS

EXPERIMENT I

Object.—The object of this experiment was to compare rice bran, corn, and a mixture of rice bran and corn as supplements to camote vines for growing pigs.

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1 Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 193.; Experiment Station contribution No. 249. Prepared in the Department of Animal Husbandry under the direction of Prof. B. M. Gonzalez.

Plan.—Beginning August 25, 1920, the pigs were weighed daily for three consecutive days. They were then divided into three lots of four pigs each; the lots were as uniform as possible. The lots were designated, Lot I, Lot II, Lot III.

In Lot I, the pigs together weighed 23.7 kilograms. Rice bran was given to this lot as supplement to camote vines.

In Lot II, the pigs together weighed 23.6 kilograms. This lot was given ground corn as supplement to camote vines.

In Lot III, the pigs together weighed 23.6 kilograms. This lot was given a mixture of rice bran and corn, equal parts by weight, as supplement to camote vines.

Feeding.—There was provided in the feed room for each lot a box in which the feed for the week was placed and from which the daily feed was taken. At the end of the week, the remaining feed was weighed and subtracted from the original weight so as to obtain the exact amount of feed consumed during that week.

The pigs were given the concentrate feed in the form of slop both morning and afternoon, an effort being made to give only such an amount each time as would be consumed within one-half hour. The rule followed was to give less feed in the morning than in the afternoon to induce the animals to eat more of the camote vines.

Camote vines to the amount of six kilograms were given to each lot at about nine o'clock in the morning. At this time, the pigs were confined in the lots until about two o'clock in the afternoon so that they ate the vines without scattering and wasting them. The amount of vines given to each lot was increased to seven kilograms during the latter part of the experiment. Not all of the vines were consumed by the pigs. That the amount consumed by each lot could be determined approximately, what was left was collected and weighed the following day before giving a new supply.

Observations.—This experiment was run for sixteen weeks, or 112 days. The animals were weighed on Saturdays in the morning, before feeding. For this purpose a small platform balance, accurate to the tenth of a kilogram, was used throughout the study. The amounts of feeds consumed by the lots during the week were determined on Saturdays at the time of the weighing.

During the first week of the experiment, there was a noticeable decline in the appetite of the pigs fed with rice bran and corn separately. This was caused, probably, by the sudden change in feed which they were forced to eat as they had been used to a mixture of equal parts by weight of rice bran and shelled corn. Care was exercised, using the appetite of the pigs as a gauge, in estimating the amount of feeds given so as to avoid "left overs".

With regard to the camote vines consumed, practically no difference, either in manner of eating or amount of the vines consumed, was observed during the first week. The pigs ate first the tips of the vines, then the leaves, then the softer parts of the stems. Later, those fed corn, chewed the stems also; the other two lots left the stems practically untouched. As the experiment went on, it became noticeable that the pigs fed corn exclusively as supplement, consumed more of the forage given them than did the other two lots. Lot III, which was

given the mixture of rice bran and ground corn, consumed less forage than the lot given corn, and more than the lot given rice bran alone. The lot that consumed less of the supplement feed consumed the most camote vines. On the average, 42 per cent of the forage given to each lot was leaves and tips and 58 per cent stems. This was determined in fifteen trials.

The camote vines given to the pigs were obtained from a well started camote field of approximately 1080 square meters. The weather, being rainy, was very favorable. The lot was well fenced. The pigs were not allowed to go over the patch. Instead, the vines were gathered and given to them. In this way the root-stocks were left to grow once more. The writer was thus able to give each lot a total amount of 690 kilograms of vines for the 112 days of the experiment and, at the end, the camote field appeared to be even thicker and more luxuriant than at the beginning. In another experiment, this same lot was used later by Mr. Peña, who placed on it sixteen Berkshire-grade pigs, and in eight days the lot was almost entirely depleted.

At the time of the experiment here reported, the current prices in Los Baños of rice bran was 9 centavos and shelled corn, 10 centavos a kilogram.

From the results of this feeding test, to produce 100 kilograms gain, Lot I, fed on rice bran as the supplement, required 14.0 per cent less feed than Lot II fed on ground corn; and 18.8 per cent less than Lot III fed on the mixture of rice bran and ground corn. Corn as a supplement did not give satisfactory returns, there being a net return of only ₱11.99 after deducting the cost of supplement feed. Rice bran and corn gave ₱17.56 net return, while rice bran gave ₱38.36.

The pigs in the three lots appeared very different at the end of the experiment. Lot I pigs were the largest animals. They seemed very healthy and nicely fleshed, but they were big-bellied, their abdomens being pendant. They stood well on their legs, had bright eyes and shiny smooth hair.

Lot II pigs were very sluggish and lanky, with arched backs, and standing bristles. Their coats were loose and the hip bones were very prominent. Their abdomens were somewhat shrunken. Their eyes appeared dull and sleepy. In general, the animals were stunted.

Lot III animals were neither so fleshy as Lot I nor so stunted as Lot II. Their bellies were well carried; backs were straight; and eyes bright. The pigs did not stand as squarely on their legs as those of Lot I. They were thrifty, however.

EXPERIMENT II

Object.—The object of this experiment was to compare the feeding values of rice bran, a mixture of corn and copra meal, and a mixture of rice bran and copra meal as supplement to camote vines for growing pigs.

Plan.—The pigs used in Experiment I were used in this study. When the first experiment was ended on December 18, 1920, all the pigs were fed the same ration consisting of equal parts by weight of rice bran and corn in addition to camote vines. To accustom the pigs to copra meal it was gradually mixed with this ration until the proportion was 1:1:1.

On December 28, the pigs were divided into three lots of four pigs each. In this division, two pigs from the first Lot I remained in the new Lot I, while one of the remaining two animals was put in Lot II and the other in Lot III. The same division was followed with the other two lots.

Feeding.—Each lot was given seven kilograms of camote vines daily. In addition, Lot I was fed rice bran. Lot II was given a mixture of two parts by weight of ground corn and one part of copra meal. Lot III was given two parts by weight of rice bran and one part of copra meal.

The procedure of feeding as regards time, amounts of feed, and methods of feeding followed in the first experiment was followed in the second. Fresh water and the charcoal mixture were provided all the time. The left over vines were weighed daily before giving a new supply.

The cost of feeds during this experiment were ₱0.09, ₱0.10, ₱0.07 a kilogram for rice bran, shelled corn, and copra meal respectively.

The experiment was run for nine weeks, or 63 days. Weekly weighings were made on Tuesdays before the animals were fed in the morning. The concentrate supplements remaining in the boxes were weighed at the end of the week and the amounts consumed were determined.

Observations.—During the first week, there was practically no difference in the amount of camote vines consumed by the lots. From the second week on, the lot fed the mixture of corn and copra meal consumed most of the forage, leaving practically only the fibrous portion of the stems. Lot III did not consume as much forage as Lot II but more than Lot I.

The amount of concentrate supplements consumed was least in the lot fed with corn and copra meal. The pigs' appetite in this lot was the poorest of all. Pigs fed with rice bran ate the concentrate supplement better than those fed with rice bran and copra meal, during the first part of the experiment. Later, the two lots consumed practically the same amounts of concentrates. There was a gradual increase of the supplements eaten by Lots I and III as the experiment progressed, but Lot II showed practically no increase in the amount of the concentrate eaten.

With regard to the development of the animals, Lot II pigs were the poorest of all. The animals were lean and lanky and did not stand squarely on their feet. They had coarse coats and prominent hip bones. Their eyes were dull. Lot I pigs were better fleshed than Lot II but were big-bellied. They stood squarely on their legs and had bright eyes. Lot III pigs were the best of the three lots, the animals being well-fleshed and in good condition. They were also big-bellied but were better proportioned than those of Lot I. Those fed with rice bran alone and the mixture of rice bran and copra meal gained practically the same, while those fed the corn and copra meal ration did not make satisfactory gains.

From Table II, it is evident that rice bran and copra meal gave satisfactory financial returns. To produce 100 kilograms gain, Lot III required 6 per cent less supplement feed than Lot I and 43.2 per cent less than Lot II. The animals made better gains than in Experiment I. Rice bran in this experiment was better used and produced better gains than when fed in the first experiment. This was likely due to the fact that as the result of the second division, stunted thrifty pigs were alloted to the rice bran lot, so they made economical gains. The pigs were also older and bigger. With pork at ₱1.25 per kilogram, the rice bran lot gave a net return, after deducting the cost of concentrate feed, of ₱57.29; the corn and copra meal lot gave ₱20.39; the rice bran and copra meal lot gave ₱61.52.

SUMMARY OF RESULTS

1. *Experiment I.*—Rice bran gave the best result as a concentrate supplement to camote vines given as soilage for growing pigs. Corn alone was not a good supplement. It stunted the growing pigs. The rice bran and corn mixture, although better than corn alone as a supplement, did not give as satisfactory returns as rice bran alone. Rice bran alone with camote vines was a bulky feed and produced big-bellied animals.

2. *Experiment II.*—Pigs fed with corn and copra meal as supplements to camote vines did not give good gains. The pigs given rice bran and rice bran and copra meal mixture as supplements gained and thrived almost the same, the rice bran and copra meal ration being slightly the better.

3. Under the conditions of the experiments rice bran was a more efficient concentrate than corn.

4. From a given area of forage, more forage was secured by soiling than by allowing the animals to graze on it.

TABLE I.—*Results of Experiment I.*

	Lot I. Rice bran, camote vines	Lot II. Ground corn, camote vines	Lot III. Rice bran, corn, camote vines
Period covering Aug. 27, 1920, to Dec. 18, 1920	112 days	112 days	112 days
Initial weight of each lot, 4 pigs	23.7 kg.	23.6 kg.	23.6 kg.
Average initial weight of each pig	5.9 "	5.9 "	5.9 "
Final weight of each lot	95.2 "	52.3 "	65.8 "
Average final weight of each pig	23.8 "	13.1 "	16.5 "
Total gain of each lot	71.5 "	28.7 "	42.2 "
Average gain of each pig	17.9 "	7.2 "	10.6 "
Total amount of supplement feed consumed	318.5 "	148.8 "	231.6 "
Total amount of camote vines given	690.0 "	690.0 "	690.0 "
Amount of camote vines consumed	539.8 "	575.1 "	567.0 "
Required supplement to produce 100 kg. gain	445.45 "	518.47 "	548.8 "
Required camote vines to produce 100 kg. gain	754.96 "	2003.48 "	1343.6 "
Cost of supplement feed per 100 kg. gain	₱40.09	₱51.85	₱52.14
Cost of supplement feed per kg. gain	₱ 0.40	₱ 0.52	₱ 0.52
Cost of supplement feed for whole gain	₱28.67	₱14.88	₱22.00
Value of pork produced, 75% dressed weight at ₱1.25 a kg.	₱67.03[a]	₱26.91[a]	₱39.56[a]
Net return after deducting the cost of supplement feed	₱38.36	₱12.03	₱17.56

[a] Pork was selling in the local market at ₱1.20–₱1.50 a kilogram at the time of the experiment.

TABLE II.—*Results of Experiment II.*

	Lot I. Rice bran, camote vines	Lot II. Ground corn, copra meal, camote vines	Lot III. Rice bran, copra meal, camote vines
Period covering Dec. 28, 1920, to March 1, 1921	63 days	63 days	63 days
Initial weight of each lot, 4 pigs	76.1 kg.	76.8 kg.	77.4 kg.
Average initial weight of each pig	19.0 "	19.2 "	19.3 "
Final weight of each lot	156.4 "	112.8 "	160.4 "
Average final weight of each pig	39.1 "	28.2 "	40.1 "
Total gain of each lot	80.3 "	36.0 "	83.0 "
Average gain of each pig	20.1 "	9.0 "	20.8 "
Total amount of supplement feed consumed	199.9 "	148.4 "	194.2 "
Total amount of camote vines given	441.0 "	441.0 "	441.0 "
Amount of camote vines consumed	297.4 "	334.1 "	306.8 "
Required supplement feed to produce 100 kg. gain	248.9 "	412.2 "	234.0 "
Required camote vines to produce 100 kg. gain	370.4 "	928.1 "	369.6 "
Cost of supplement feed per 100 kg. gain	₱22.40	₱37.10	₱19.50
Cost of supplement feed per kg. gain	₱ 0.22	₱ 0.37	₱ 0.19
Cost of supplement feed for whole gain	₱17.99	₱13.36	₱16.18
Value of pork produced, 75% dressed weight at ₱1.25 per kg.	₱75.28	₱33.75	₱77.81
Net return after deducting the cost of supplement feed	₱57.29	₱20.39	₱61.63

REVIEW "THE HIGHER EDUCATION OF THE FUTURE"[1] [2]

Speaking with the well-grounded authority which befits his long incumbency of a chair in the Gembloux (Belgium) Institute of Agriculture and his membership in the Royal Academy of Science in Belgium, Professor Marchal discovers that two plans of higher agricultural education have held:

(1) Students attracted, preferably from country districts; allowed easy entrance to the institution; provided within a minimum time, a correction of current practice by careful theoretical and practical instruction through emphasis upon the field rather than the laboratory. These students upon graduation return to the land and become something in the nature of local examples. This plan envisages the training of students only to "disseminate the knowledge of the progress already attained".

(2) Schools of distinctly university and research character which would train any class of agriculturally inclined, completely prepared entrants, through relatively long and thorough scientific grounding, to not only disseminate current optimum practices, but also to act as "pioneers, research workers, and molders of future agricultural progress".

Professor Marchal subscribes heartily to the second plan and adduces clear argument therefor. He finds three phases in practical progress: (1) The theory established by pure science without regard to economic value; (2) The "applied" scientist grasping and clarifying the economic aspect of every theory and formulating the necessary concomitant technique; and (3) The dissemination. The modern agricultural institution should find its measure upon the second and third points, or to quote, "pre-eminently to secure the necessary liaison between pure theoretical science and practice and to select from among the original abstract theories of laboratory experts, the ideas that lend themselves to practical application, testing and adapting them to the actual requirements of agricultural technique and finally and above all, to arrange for their general diffusion".

In addition, Professor Marchal directs attention to a general scientific preparatory training which should include the mathematical, physico-chemical, mineral, and biological sciences and in each of these fields the "agricultural student should receive a training in no way inferior either in range or standard to that required for a degree in pure science." Again, "The university * * * is undoubtedly the most favorable milieu for the purely scientific training of the agricultural scientist of the future."

A research station staffed with eminent scientists is laid down by the writer as a necessity in higher agricultural education.

The article discusses with great intelligence the place of practical exercises in modern agricultural education and finds that "the subject of practical application in higher professional instruction should take the form of training the student

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[1] MARCHAL, E. The higher education of the future. *International Review of the Science and Practice of Agriculture* (Rome) New Series 1, 2: 1-6. 1923.

[2] General contribution from the College of Agriculture No. 120.

how to observe, measure and analyze, to complete his knowledge by means of documentation, and to initiate him into experimental method and individual research".

Professor Marchal concludes that "A high level of preliminary scientific education, a far-reaching general professional training and a moderate degree of specialization, such should, according to the views of the writer, be the qualifications which the agricultural scientist of tomorrow should be expected to supply."

The article should find a local appreciation due to two considerations:

(1) The dangerous practice in the Philippines of looking upon an artificial and in reality a *non est* gap between "science" and "practice".

(2) The insistence of the authorities of the College of Agriculture, University of the Philippines, upon several ideas that are clear-cut in Professor Marchal's article: (a) The basing of local instruction upon intense work in the pure sciences of botany and chemistry, even at a time when so high an official as a President of our University once exclaimed that "Los Baños needs no department of botany"; (b) The finding of our own Colleges that the classical non-scientific high school does not prepare for higher agricultural education and the consequent insistence upon our own two-year preparatory curriculum; (c) The plans long underway, but at present withheld for economy's sake, of establishing a model scientific high school; and (d) The ever increasing insistence of our Dean and Faculty upon the staffing of our experiment station which has for eight years existed only as a piece of land.

—*Reviewed by* Evett D. Hester.

ABSTRACT[1]

Clarification in raw sugar factories. Manuel L. Roxas and Angel A. Africa[2]. (*Report First Annual Convention Philippine Sugar Association, Manila, Philippine Islands, 1923*).—"In the manufacture of raw cane sugar the general process of clarification consists simply in adding to the juice the amount of lime found best by experience, heating the juice to the boiling point, and subsiding the mud in settling tanks or eliminators."

The present practice of juice defecation in the Philippines is similar to that followed in the Hawaiian Islands, where, according to Johnson, the study of clarification has received but little attention. There is no careful and accurate liming of the juice; "pick-up" cane juice and juice from fresh cut canes are limed about the same, and Yellow Caledonia receives the same treatment as H109 cane. "The correct limits of alkalinity or acidity for different canes or conditions whereby the clearest juice may be obtained, the maximum recovery of sucrose, the minimum loss due to inversion or destruction of sucrose are not known". The practice of liming varies in different centrals; some lime the juice short of neutrality to phenolphthalein and others lime just alkaline to litmus.

The authors of this paper had two objects, (a) To report on the preliminary results obtained with the use of Deerr's method in determining the proper reaction for liming in defecation in raw sugar manufacture; (b) To offer suggestions for further investigation of the subject in its application on a factory scale on the problem of proper and practical control of liming in raw sugar factories.

The method first suggested by Deerr was followed by the junior author in the experiments. The tests consisted in titrating the juice for total acidity. In a series of test tubes 10 cc. portions of fresh samples were placed; then into each test tube a gradually increasing volume of clear lime water was added. The juice was heated to boiling and then allowed to settle for fifteen minutes. The test tube with brightest supernatant liquid was marked and the residual acidity was noted.

"In another set of experiments, after determining the acidity, increasing amounts of clear lime water were calculated for 100 cc. of juice so as to produce an acidity gradually decreasing by 2 cc. of the lime water to 100 cc. juice. Such amounts were added to the juice contained in a series of beakers; the juice brought to boiling, allowed to settle, the clearest marked and filtered, and the purities determined." The same juice was limed to residual acidities close to 0.2 cc. The acidities in terms of pH values were calculated with the use of the formula given in Clark's "The Determination of Hydrogen Ion". It should be noted that in these tests the addition of lime water was extended beyond the phenolphthalein neutral point, in which it was found that "the clarity of the juice increases upon the addition of alkali up to a certain hydrogen ion concentration below the neutral point, beyond which the juice becomes turbid up to certain alkali point, when the juice becomes clear again although with a deeper color".

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[1] Abstract prepared as part of required theme work in English 101, College of Agriculture.

[2] The experiment reported in the paper the abstract of which is here given was carried out by the junior author, under the direction of the senior author, and presented as his thesis for the degree of Master of Science from the College of Agriculture, University of the Philippines, 1923. Thesis No. 167. Experiment Station contribution No. 202.

With regard to purity and clarification, the tests made show that alkaline defecation to the point of maximum clarity causes a greater increase in purity: 3.5 per cent, as against an average of 2.96 per cent, for the acid defecation. The results here noted confirm the reported results obtained from a number of factories in Hawaii.

From the results of the experiments performed the authors made the following conclusions:

"1. The *end reaction* to be attained or residual acidity to be left in liming different juice varies according to the nature of the cane, and does not seem to have fixed pH values.

"2. When lime is added to cold juices in gradually increasing amounts and they are brought to boiling, then allowed to settle, two points of maximum clarity are obtained; one on the acid side of neutrality (pH = 7) and the other on the alkaline side. The acidities producing brightest juice on the acid side lie, for the juices studied, within residual acidities ranging between 0.01 and 0.58 cc. normal per 100 cc. juice referred to phenolphthalein neutral point. When these acidities are expressed in pH values calculated with the aid of an approximate formula the acidities correspond to figures ranging between 5.22 and 6.50. The pH values for optimum clarity on the alkaline side lie between 11 and 12.

"3. For close control of liming in a factory where the nature of the juice varies for every tankful, it is desirable to determine the right reaction to lime *for every tankful of juice.*

"4. For the most satisfactory way of controlling the liming of juices in a raw sugar factory, it is very desirable that an automatic or semi-automatic apparatus be devised that will determine the right defecation point and at the same time correlate such a point with the accurate amount of lime to be added to the tankful of juice and automatically add such amount, the whole operation requiring a few minutes. The senior author has been working on the design of such an apparatus, and will report on the results in the very near future.

"5. It is recommended that the use of a self-recording potentiometer be experimented with to find out whether it can be used with raw and clarified juices."

—*Abstract by Valeriano M. Sarmiento.*

EXCHANGE NOTES

The smallest fish in the world live in Lake Buhi in southern Luzon, the largest of the Philippine Islands. These ichthyological midgets are only about half an inch long when full grown and sexually mature, and are so very slender that they are much smaller than any other fish. They belong to the family of gobies, distinguished by a sort of sucking disk used for attaching the fish firmly to stones. The only big thing about this fish is its name, *Mistichys Luzonnensis* H. M. Smith. These minute gobies occur in such vast numbers in Lake Buhi that they are the object of an important local industry. They are caught in enormous numbers by means of cloth nets and are not only used in the town along the shores of the lake but are also shipped for considerable distances. Tabios, or sinaparan, as they are called in the Bikol language, are eaten fried when freshly caught and are pressed into cakes and dried when the market is overstocked. A hungry workman literally eats thousands of fish at a meal.

—*Science.*

Three hundred farm women, attending a short course for local leaders at the University of Maryland, spent June 20 sightseeing in Washington as a part of their course. They visited the Capitol, Library of Congress, Smithsonian Institution, Department of Agriculture, and the White House. At the department they were welcomed by the Secretary and members of the office of extension work and Bureau of Home Economics. They were later received at the White House by Mrs. Coolidge.

—The *Official Record*, U. S. Department of Agriculture.

That lemon and lime juices possess remarkable curative properties when administered to human subjects suffering from scurvy has long been known. For many years these juices have been included in the dietary of sailors whose access to fresh vegetable food is restricted. The exact identity of the antiscorbutic factor of citrus juices has not yet been established, but it is believed that it is a vitamin of accessory food substance of specifically vital importance. . . . . Should easy means of isolating the antiscorbutic factor of citrus juices be elaborated at some future date, it might be possible to utilize the waste liquors from the calcium citrate precipitation-vat of the citrus factory for the preparation of this very valuable medicament.

—*Tropical Agriculture.*

For the purpose of assisting in the importation of foreign rice to make up for the deficiency in Japan's rice crop last year, the Japanese Government has decided to purchase about 5,000,000 bushels of rice for delivery before July, 1924, according to reports received by the Department of Commerce. This purchase is to be made by the means of public tenders through several rice dealers appointed for that purpose. The Government will pay for the rice with special rice notes maturing March 31, 1925, which can be discounted at the Bank of Japan at the current discount rate.

—*Crops and Markets* (U. S.)

If the average farmer were a success we would hear less about government aid in the fixing of prices and the marketing of our crops. If the average man in town were a success, the courts would have lighter dockets because of the absence of cases in bankruptcy.

The average man, whether he be a farmer or a city business man, will always be with us, but there is no law against raising the average. . . . . .

Production on a profitable basis is becoming more of a science as time passes, and disposing of the crop requires business forethought and business sagacity. The farmer to succeed must have something besides muscle. He must have initiative; a knowledge of soil and how to maintain its fertility; he must have a farm program elastic enough to fit seasonal conditions and be able to apply business principles in not only making his program, but in accounting it even in the sale of his products.

—*Farm and Ranch.* Quoted in *California Cultivator.*

Boys' and girls' club members carried on more than 37 per cent of the demonstrations of better practices in farming and home making completed under the direction of cooperative extension workers in 1923. . . . . .

Distributed over all the 48 States, the figures for 1923 show, were 428,000 demonstrations of the latest improved methods of conducting farm and home activities. They were carried to completion by 250,000 club boys and girls and the methods and results called to the attention of the communities in which they were placed. In these demonstrations 43,000 acres of crops, valued at $2,000,000 were grown; 105,000 farm animals were fed and cared for until they reached a value of $3,000,000; and 563,000 head of poultry, valued at $978,000, were raised. Club members prepared during the year 103,000 well-balanced and well-served meals in their own homes and 102,000 hot school lunches; baked 102,000 loaves of bread; canned 1,848,000 quarts of fruits, vegetables, and meats; dried 196,000 pounds of food; and brined and cured 106,000 pounds of meats and vegetables. More than 528,000 articles of clothing, valued at $647,000, were constructed, remodeled, or selected by club standards of suitability, healthfulness, and becomingness. . . . . .

Increasing interest in the advancement of extension work for farm boys and girls was manifested during the year by business men, educators, and other men of affairs, culminating in the acceptance by the President of the honorary chairmanship of the national committee on boys' and girls' club work.

—*The Official Record.* U. S. Department of Agriculture.

COLLEGE AND ALUMNI NOTES

Mr. A. Despeissis, acting superintendent of agriculture, Suva, Fiji, has kindly furnished the Department of Entomology with a life-history set of *Levuana iridescens* Bethune-Baker, a small moth which plays havoc on the coconut in Fiji. Fortunately, this serious pest has not yet found its way into the Philippines.

The *Boletín de Agricultura, Industria y Comercio de Guatemala* reproduced in Spanish in the May issue under the caption "Ojeada sobre las enfermedades de las aves de corral en Los Baños (Islas Filipinas)" Doctor Fronda's paper "A survey of poultry diseases in Los Baños," which appeared in the October (1923) number of the PHILIPPINE AGRICULTURIST.

Mr. Juan Espíritu of Calamba, Laguna Province, presented the Department of Entomology with a beautiful and carefully prepared model of a *baklad*, a kind of fish trap commonly used by commercial fishermen on Laguna de Bay. The model was a first prize winner in the municipal exhibits at the Laguna Provincial Fair in May.

The wild pig, which was a feature of the Animal Husbandry exhibit at the Laguna Provincial Fair held in May, was butchered in August. This animal was caught on Mount Maquiling when only about three weeks old. She was raised on carabao's and cow's milk. She was about four years and three months old when killed. She was in good condition weighing 48 kilograms; she measured about 57 cm. in height and 112 cm. in length. Repeated attempts to breed her had failed. On post mortem examination the body was found singularly free from parasites, only two immature round worms (*Ascaris lumbricoides*) were found in the intestines and a number of filarids (*Arduenna strongylina*) in the stomach. No kidney worms were found although her herd mates (grade Berkshires) are infested. The skin of the animal has been mounted. The Philippine wild pig is supposed to belong to the species *Sus vittatus*.

A large crocodile, weighing over twenty kilograms, was recently caught in the Maitim River, near the Experiment Station grounds, by a farm laborer. It was purchased from funds donated by Dean Baker and the mounted skin added to the zoological collection of the College.

Through Mr. A. F. Fischer, Director of Bureau of Forestry, the Department of Entomology was recently the recipient of gifts of insects and other zoological specimens from the Bureau personnel. The donors of the specimens and the regions from which they were collected are: Forest Supervisor Agapito Cenabre, from Bukidnon; Forest Supervisor Macario Mariano, from Mount Isarog; Ranger Felipe Salvoza, from Polillo; and Ranger Manuel Malana, through Forest Supervisor Juan Lopez, from Cagayan, Misamis.

An appropriation of ₱1,500 by the Board of Regents made it possible to rebuild the hog barn which burned down July 23.

Our foreign graduates seem to be finding opportunity in their respective homelands to put into practice the knowledge which they came to this College to obtain. Mr. E. de Braganza Pereira, B.S.A. '21, writes Dean Baker that he is agriculture expert in *Direccao dos Servicos Agricolas, Florestais e Pecuarios da India Portuguesa, Zona Agricola do Norte.*

From letters from Mr. Thongdee Resananda, B.S.A. '24, to Prof. Emma S. Yule and Doctor Fronda we learn that Mr. Resananda is on the faculty of the Agricultural Teacher's Training College, Nagor Pothom, Siam. He is teaching animal husbandry subjects, hygiene, arithmetic, and has management of the swine herd and poultry flock. Quoting: "I have a mind to start a flock of White Leghorns next December. At present I am trying to raise some capons for the market. . . . . We have a modern White Leghorn farm. It belongs to a real prince who retired from government job (with monthly pay of ₱800) to become a farmer. He is a well educated man. His W. L. stock comes annually from California. Eggs from his plant are selling for about 50 per cent more than the common eggs. In general farming water melons are his main money crop. His melons are very well known and sell at ₱2 and ₱3 each. So far he is quite successful in his undertaking."

Mr. Iang Chandrastitya, B.S.A. '21, who after graduation spent two years in Cornell University, Mr. Resananda writes, is now one of his fellow faculty members.

Dr. Faustino Q. Otanes, '18, assistant entomologist in the Bureau of Agriculture, was a recent visitor at the College for the purpose of consulting with Dean Baker and with the Department of Entomology.

Gil O. Opiana, B.S.A. '23, assistant in Analytical Chemistry in the Department of Agricultural Chemistry, has just qualified at the last examination given by the Bureau of Civil Service for Inorganic Chemists. This is considered to be rather a distinction for one who has not taken a regular course in chemistry.

Mr. Opiana took the examination together with Doctor Lava, Mr. Tirona, Mr. Espinosa and others from the Bureau of Science, all holders of higher degrees in chemistry.

Mr. Deogracias V. Villadolid, M.S. '23, instructor in entomology in this College who, with Mrs. Villadolid is now in the United States, is taking post-graduate work in Stanford University. His address is 705 Cowper Street, Palo Alto, California.

Mr. Canuto G. Manuel, '24, has been appointed graduate assistant in the Department of Entomology. He takes part in conducting laboratory instruction in zoology 1.

Mr. Feliciano R. Reveche, '23, formerly a graduate assistant in entomology is now a teacher in the provincial high school at San José, Antique.

The Index for Volume VIII of the PHILIPPINE AGRICULTURIST is now in print. This index was prepared by Dr. Valente Villegas of the Animal Husbandry Department.